The Nagpur Agricultural College Magazine

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AGRICULTURAL COLLEGE, NAGPUR

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J. C. MacDougall Esq., M.A., B.Sc.

Our New Principal

Our New Principal

THE appointment of Mr. J. C. McDougall, M. A., B. Sc., as the Principal of the Agricultural College will be acclaimed by one and all. A better choice could not have been made by the Government. Mr. McDougall comes to us with an experience of a wide and varied character, such as has been the lot of few persons to achieve in a short period of service. On leaving school Mr. McDougall was engaged for some time in private farming in Scotland. Subsequently he joined the Edinburgh University where he took his M.A. and B. Sc. in Agriculture. After a period of active service in His Majesty's Forces, he joined the Indian Agricultural Service in 1920. During the last twelve years of his service in the Central Provinces he had opportunities of serving in various capacities in most parts of the province. In 1926 he was appointed Assistant Secretary to the Royal Commission on Agriculture in India. In this capacity Mr. McDougall had the unique opportunity of studying at first-hand the agricultural and rural conditions of the whole of India—an opportunity vouchsafed to few persons so early in their career.

Mr. McDougall carries a very high sense of duty, and has an infinite capacity to take pains. Whatever he has taken up, he has adorned with his ability and perspicacity.

To these high intellectual qualities Mr. McDougall combines a very kind and sympathetic heart and the rare gift of understanding the view-point of others. His calm and affable manners and his interest in the welfare of those associated with him have won for him the unquestioned loyalty and ungrudging service of all who worked with him. We have no doubt that he will make a very successful Principal, inspiring and popular, both among the students and the staff. We wish him the best of luck in his new office.

Foreword

By J. C. McDougall, M.A., B.Sc.
(Principal, College of Agriculture, Nagpur)

In this issue certain changes have been introduced on lines which are described in detail in the Editorial Note. A serious effort is in progress to widen the scope of the magazine and to make it a publication of genuine usefulness not only to present students but to past students as well. There must be many past students who, through lack of time or opportunity, find it difficult to keep abreast with current literature on agricultural subjects, but who are in a position to contribute articles of general interest on subjects lying within their own experience. It is the aim of the Magazine Committee to supply useful information in a concise form to such people and to enlist their support in return, thereby rendering useful service to present and past students alike. An earnest appeal is made to past students, and to others connected with research and extension work in the Agricultural Department, to assist the Committee in securing its immediate objective by subscribing to the magazine and by contributing suitable articles for publication. Given adequate support, the magazine cannot but be a success, for few publications of such modest pretensions have such a wealth of potential subscribers to draw upon for information. And, if the primary objective is secured, the way will be open for still further development. An agricultural magazine which is of real value to agricultural students and departmental officers cannot fail to make a still wider appeal. It must commend itself to all who take an interest in progressive agriculture and in general rural welfare.

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Editorial

WITH this issue we enter into a new volume. Our magazine has now been in existence for six years—a period sufficiently long to warrant the statement that the magazine is now a well-established activity of the College. It is a matter of considerable regret to us that some of the persons largely responsible for the conduct of the magazine in the past have had to sever their connection with it recently. We take this opportunity to express our sincere thanks to those persons but for whose efforts the magazine would never have had such a flourishing career.

Our late Principal, Mr. R. G. Allan, showed considerable interest in the magazine, and always helped the editors with his advice and contributions. We will miss his guiding hand in the future, but we are glad to think that he will continue to take the same interest. We hope soon to publish an article from his pen.

All these six years of its life the magazine has been very closely associated with the name of Mr. S. B. Karkarey, our lecturer in English, whose services in the College terminated with effect from the 15th of June. We are sorry to lose his long experience in matters connected with the magazine.

A change in the personnel of the management need not necessarily involve any great change in its policy. We have no intention to make the College magazine a "departmental bulletin." But we would aim at making the magazine a publication of some use to students of agriculture which they can

read and study and preserve for future use. We also wish to make it useful to our old boys, of whom we have a large number scattered all over India. Their business keeps them confined largely to rural areas where they tend to get out of touch with the progress of scientific agriculture. We would endeavour, through the pages of this magazine, to keep our old friends in touch with modern agricultural research in all its aspects. With this end in view we have slightly enlarged the scope of the magazine, every issue of which in future will contain a number of sections, besides original articles and college news. The section entitled "Current Research" will contain short abstracts of important papers on agricultural subjects published during the quarter. The section "Gleanings" will contain scraps of information of a scientific character and of interest to agriculturists culled from here and there; and news relating to developments of an agricultural nature will be found in the section "Notes." We shall also publish, from time to time, extracts from important papers. These, we hope, will prove of great use to our old boys, and to others who wish to keep in touch with the progress of agriculture in this country. A college magazine should cater not merely for those in the College but also for those who have gone out of it, and it is our earnest desire that this magazine should serve as a link between the old boys and the *Alma mater* to the ultimate benefit of both.

We would not rest content even here. We would, if possible, attempt to reach that growing section of the educated public in this country who realize the importance of progressive agriculture in the advancement of the nation. It is upon this section of the people that the future of agricultural progress in this country lies. The success of all research and improvements depends on the readiness with which they are taken up by the enlightened public, and we hope that our magazine will prove of some practical use to such people.

This, in short, will be our policy in the future and this is the only change we contemplate, if a change it can be called.

The new agricultural season has just started. The rains have come in time and in sufficient quantity and the cultivators are busy everywhere preparing their lands for sowing. The past year has been one of the most calamitous known to agriculturists. The fall in the price of agricultural produce during the last two years has had no parallel in modern times. The distress of the agriculturists has been intensified in our province by the failure of crops in several places. Suspension and remission of land revenue and other measures of relief were granted by the Government wherever it was found necessary and this has done much to mitigate hardship in our province. The end is not yet in sight. We cannot even say whether we have passed the worst. The storm cannot continue indefinitely. There is always a calm after the storm, and we fervently hope that the year that has just started will take us back to plenty and prosperity.

Original Articles

THE CONSOLIDATION OF AGRICULTURAL HOLDINGS IN CHHATTISGARH, C. P.*

BY P. D. NAIR, M.A., L. AG. (HONS)

Introduction.—Undoubtedly the most serious obstacle to the improvement of Indian agriculture is to be found in the continuous subdivision and fragmentation of agricultural land. The majority of the holdings have been so reduced in size that they cannot fully engage the labour and capital goods at the disposal of the owners. What is worse, these small holdings are split up into a number of small fragments lying scattered all over the village with the result that they have become extremely inconvenient to manage. These fragments are often

* The material for this article was collected by the writer during a recent tour through Chhattisgarh. He wishes to express his thankfulness to Mr. R. G. Chaurey, the Consolidation Officer, for his valuable help in studying the work in progress and also for the figures concerning the progress of consolidation in Chhattisgarh.

situated so far apart that much valuable time and energy are wasted in going from field to field during critical periods and often results in the complete neglect of plots that are inconveniently situated. This extreme fragmentation is in large measure responsible for the poor cultivation found all over India and also for the comparative absence of permanent improvements on land.

The seriousness of this growing evil is now recognised by all including the cultivators themselves; but no lasting remedy can be found unless far-reaching changes are made in the Hindu and Mahommedan laws of inheritance. No one seems bold enough to suggest such a revolutionary change—not even a Royal Commission. Though it is difficult to cut the evil at the root it is possible to mitigate its worst effects and to give temporary relief by a process of consolidation of the fragmented holdings if all the right-holders in a village desire to take advantage of it. A holding, thus consolidated, would still stand the chance of being sub-divided and fragmented at the next family partition. The Punjab and the Central Provinces Governments have been devoting some attention to this problem of consolidation of the cultivators' holdings, and a considerable measure of success has been achieved in both the provinces. In the Punjab, where a spirit of co-operation has been fostered amongst the peasantry by the spread of the co-operative movement, they have preferred to work on a co-operative basis by the organisation of "Co-operative Consolidation of Holdings societies." In eight years they have been able to consolidate more than a lakh of acres, and the average size of the plot in the consolidated villages has increased from 0.7 acre to 3.6 acres.

The Government of the Central Provinces has been working on the problem now for more than half a decade, and the results achieved by them are of considerable interest to people all over India. The work has several points of interest. In the first place, consolidation is being carried out on the basis of a permissive Act of the Legislature—a method about the success of which many people were sceptical till very recently. Secondly, the work is being done in a tract where soil conditions offer the most serious obstacle to exchange of land. Where soil is uniform, as in the Punjab, exchange of one piece of land for another is not so difficult. In a Chhattisgarh village, on the other hand, one always finds at least four different kinds of soils, and the local agricultural practices make it necessary that every man must have a piece of land in every kind of soil. Thirdly, the people amongst whom the

work is being carried out are amongst the most backward, and in the words of a person who knows them very intimately, "the most litigious" in all India.

2. **Fragmentation in Chhattisgarh.**—Fragmentation of holdings is a very serious evil in Chhattisgarh which is the most important rice-growing tract in the Central Provinces. It is quite common to find an average holding, which is about 12 acres in area, split up into 30 or 40 fragments scattered all over the village. One factor which has contributed largely to the fragmentation of holdings in this part of the country is the old (and now obsolete) tribal custom known as *Lakhabata*. This custom is based on the existence in every village of different kinds of soils of varying productive capacity ; and to ensure an equitable distribution of the burden of land revenue it was thought necessary to give each tenant a share in the different soils of the village. There were periodical redistributions which corrected any excessive fragmentation. But such redistributions have not taken place since the country passed under British rule with the result that fragmentation is now a very serious evil blocking the progress of agricultural improvement at every step. In several cases plots are so small that ploughing with bullocks has become difficult. In some places as much as 10 per cent of the land is taken up by *bunds* and boundaries.

3. **Difficulties in Chhattisgarh.**—Consolidation in Chhattisgarh has a fairly long history. As early as 1905 two villages were consolidated in the Bilaspur District, through the effort of Mr. Laurie, then Commissioner of Chhattisgarh. A few more isolated villages were done in subsequent years through the efforts of revenue officers. Some progressive *malguzars* took up the idea and managed to consolidate their home farm, and in some cases their whole village, without Government aid.

These early attempts at consolidation or, *Chakbandhi* as it is known locally, though not very successful, served to bring out the peculiar difficulties involved in the problem of consolidation in Chhattisgarh. One serious difficulty was the invariable presence of heavy, medium and light soils in every village, in well-defined blocks known as *khars*. Rice cannot be grown on all lands, and only portions of the village have irrigation facilities. Every man must have some of rice and non-rice land and also a share in the irrigated portions of the village. For these reasons consolidation can never be on a one-block basis. It can

only be by blocks of soil, and because each village has at least three different kinds of soils, every cultivator must necessarily have his holding in at least three places.

The most serious difficulty, however, was of a legal nature, arising from the complications of the *malguzari* system of land tenure. The law, as it existed before 1928, did not allow the cultivator to acquire a clear and undisputable right over the lands they receive in exchange during consolidation. There were certain provisions in the C. P. Land Revenue Code and the Tenancy Act which permitted consolidation. But they were ineffectual, and the cultivators were afraid lest the process of consolidation should deprive them of their only source of livelihood.

4. **The Act of 1928.**—Mr. J. F. Dyer was appointed Commissioner of the Chhattisgarh Division in 1927. He made a thorough study of the problem and brought to the notice of the Local Government the points on which legislation was required if consolidation was to be a success in this province. On the lines of his recommendations "the C. P. Consolidation of Holdings Act" was passed in 1928. The operation of the Act was confined to Chhattisgarh Division, and a special Consolidation Officer was appointed to carry out the work. He was empowered by the Act to enforce *Chakbandhi* on a recalcitrant minority if not less than one-half of the permanent right-holders holding together not less than two-thirds of the cultivated area in the village confirm a scheme prepared by the Consolidation Officer. The Act also provided for the transference of encumbrances and rights to the new holding. When these legal difficulties were removed, the work became easier and more popular.

5. **The Procedure.**—The procedure adopted is very simple. In every village, where consolidation is proposed, a *panchayat* is appointed three of whom are elected by the villagers and two nominated by the Consolidation Officer. All the processes connected with the redistribution of holdings are done in the presence and with the consent of this *panchayat* and the right-holders concerned. The first process is the division of the village lands into natural blocks or *khars* according to the kind of soil and other natural conditions. Then the productivity of every field is valued in terms of annas. Twenty times the seed is the maximum outturn ever obtained in these parts. Four times the seed is deducted for expenses of cultivation and so sixteen times the seed is the net outturn from the very best field. Such a field is valued 16 annas.

If a field yields twelve times it is 12 annas, and if eight times, 8 annas. Fertility, communication facilities, and distance from the *abadi,* or village tank, and grazing area, are all taken into consideration in valuing productivity. A distant field loses its value by 2 annas, and one near the grazing area would lose 1 anna. The best non-rice field is 8 annas, and so on. The anna valuation multiplied by the area gives the productive units. The productive units possessed by every holder in the village are separately worked out.

Then in consultation with the *Panch* and the tenants, the Consolidation Officer has to decide the basis of redistribution of holdings in the particular village. Where soil conditions differ widely in each *khar*, the cultivators are found unwilling to exchange land of one *khar* for that of another *khar*, and so *kharwar chakbandhi* has to be adopted, and every cultivator will have as many plots as there are *khars*. Where conditions do not vary very much, and the village small and compact, one block system will be welcomed. If the village is a very big one, with lands extending to miles on either side, then every man must have one block in the distant *khar* and another in the near *khar*. In certain cases *jatwar chakbandhi*, *i.e.*, grouping the holders according to their caste, has been a success.

In working out the new holdings the aim is to give the holder the same number of productive units and not always the same area. This method satisfies the ordinary cultivator more than the method of giving him area for area. For, after all, what the cultivator wants is that he should be able to raise the same amount of crop, and if he knows definitely that the new land he is going to get will enable him to reap the same amount of crop, he is satisfied even though there is slight difference in area. This system has another advantage. If the basis of the new allotment is area for area, the cultivator is always suspicious that he is losing superior land and receiving inferior land in return, and this makes him reluctant to come into the scheme unless he is assured that what he considers his best land would be secured to him and the new holding built round this. This leads to endless difficulties. The best lands are always near the *Abadi* or the tank, and it is impossible to build everybody's holdings round about there. When the new allotment is done on the basis of productivity the cultivator is prepared to accept land in any part of the village provided he is not assigned to any unduly

disadvantageous corner. Generally a man is established in that *khar* in which he had most of his land in the old order.

6. **Progress of the Work.**—The passing of the Act and the devising of a simple and appealing method of carrying out consolidation has given a great impetus to the work. During the two years between 1926 and 1928 when the work was done on a voluntary basis, only 9 villages could be consolidated while 13 villages were done during the next 8 months with the help of the Act. Progress has been wonderfully rapid since then. Between June 1929 and September 1931, 142 villages comprising an area of 117,761 acres were consolidated. The total number of villages so far (September 1931) consolidated in Chhattisgarh since 1926, when the work was first taken up in earnest, is 167, comprising an area of 142,694 acres and affecting 11,836 permanent holders. Before *chakbandhi*, these 167 villages had 287,959 *khasra* numbers; consolidation has reduced this to 44,910 or less than a sixth. These consolidated villages lie scattered all over the districts of Drug, Raipur and Bilaspur, and are doing the most effective propaganda for consolidation in Chhattisgarh. The neighbouring villagers have begun to see the advantages of consolidation and are now coming forward of their own free will to effect *chakbandhi*, undertaking to pay full costs. Applications for consolidation are now coming forward in such large numbers that the Consolidation Officer cannot cope with the work with the limited staff at his disposal. Till the 14th of December 1931 there were 550 applications for consolidation, but only 167 have been taken up and completed.

7. **The Effect of Consolidation.**—The effect is marvellous. The appearance of the village land is entirely changed. To one going about in an ordinary Chhattisgarh village it would appear as though there is more land under bunds than under crops. The minutely subdivided and ill-shapen fields with their crooked boundaries have given way to large fields with straight boundaries. It is now possible to see in some of the consolidated villages single unbroken fields 7 or 8 acres in area, something unknown for generations in the past. The new holding of a cultivator can be distinguished by the big bunds that surround it, while the partitions within have been reduced to the minimum in number and size consistent with the level and water-holding capacity of the soil. Every cultivator has now a threshing floor near the village site. In all consolidated villages new pathways have been made and

the old ones made broader to facilitate the movement of men and cattle. The old distribution of the fields was particularly wasteful and inconvenient for irrigation. There were no special water channels and water was allowed to flow from the higher fields to the lower. Thus the man at the lower end would get water only when the requirements of those above him are satisfied. *Chakbandhi* has now provided them with regular water-courses and this has made it possible for all to get water whenever they want.

Consolidation has given a stimulus to carry out permanent improvements on land. In several of the consolidated villages levelling is in progress and several new wells are being dug. Cultivators are taking loans from Co-operative Societies for the purpose of improving their holdings.

Consolidation is bound to produce considerable effect on the social life of the village. Where there were caste and communal factions the *jatwar chakbandhi* has brought peace by isolating the conflicting elements. Where the *malguzars* and the tenants have been constantly quarrelling *chakbandhi* has established harmony by separating them and establishing them in different parts of the village. *Chakbandhi* has also reduced the opportunities for encroachments, thefts and for cutting pathways; it has thereby reduced the occasions for quarrels and litigation.

Another important advantage which consolidation has brought in its train is the tremendous reduction in the work and records of the Revenue staff and the consequent possibilities of a heavy reduction in the ever-growing machinery of the Revenue Department. The *patwari* records have been reduced to less than one-fourth of their original size. Where originally 50 entries had to be made against a man it is now reduced to 4 or 5, and there is now no need for the constant correction of boundaries and stones. It is now possible for a *patwari* to look after the work of a much larger number of villages.

All the blessings enumerated above are purchased at almost negligible cost. At the beginning of the work the cost of consolidating an acre worked out to Re. 1-7-0. As the staff became more and more experienced in the work, it has been possible to reduce the cost to less than one-fourth. During the year 1931 the cost of consolidating an acre worked out to the paltry amount of Re. 0-5-6. The cost is considerably higher in the Punjab. In 1927, after about eight years of work, the cost varied from Re. 1-6-0 to Rs. 2-11-0 per acre.

Consolidation of holdings is one of the most urgent economic reforms required in India. Any attempt to improve Indian agriculture, such as the introduction of better varieties of crops, better implements, better manures, etc., can never reach the mass of the cultivators till this evil of scattered plots is removed. The old platitude that the Indian cultivator is conservative, that he loves litigation and that he is against consolidation has no foundation. Nobody realises the need for and the advantages of consolidation more than he does. His fear is that he might lose in the bargain. If he is convinced that it will cause him no loss and will not involve him in endless litigation, he comes forward freely and is even willing to pay the whole cost as in Chhattisgarh. In view of the supreme importance of the question and the tremendous effect it has in improving the agricultural and economic conditions of the country and of the people, consolidation deserves much more attention than it now receives. A ten-year plan of consolidation is the most urgent agrarian reform required in this country and, if carried out, would bring untold blessings to the millions of cultivators now struggling to keep body and soul together with the scanty produce of their sub-divided and fragmented fields.

GUTTERFLY OR BLOWROOM REFUSE—ITS USE AS MANURE

By B. S. Rao, L. Ag. (Hons.)

When cotton bales are opened and blown in the blow room of the mill, a waste product is obtained which consists of finely-broken cotton fibres and broken and entire cotton seeds which had found their way into the bales along with the lint from the ginnery. This waste material is known as "Gutterfly."

Gutterfly is entirely different from "waste cotton" which consists of broken or soiled yarn unsuitable for the manufacture of cloth and which is generally used for cleaning machinery. It is also different from "cotton waste" which is only soiled lint without any admixture of broken seeds.

The disposal of gutterfly which accumulates in every cotton mill, involves heavy expenditure. Till 1919 the Empress Mills had to spend nearly Rs. 1,000 per annum to get rid of the stuff which could not be utilized even as fuel to heat their boilers.

In the year 1919 the contractor who had undertaken to remove the gutterfly from the Empress Mills on payment of Rs. 900 by the mills, discovered that the land on which he had left the so-called rubbish gave excellent crops in the following year. This observation suggested its utility as a manure. The mill authorities, on becoming aware of the usefulness of gutterfly, began to auction it. Customers were not wanting. The gardeners of Jaitara village were quick to realize the utility of the new manure. They tried it in 1920 and were so satisfied with it that they were willing to pay up to Rs. 1,600 for the total annual output of 500 tons from the Empress Mills.

The application of gutterfly on the College Farm dates from 1926—27 when only 10 carts were applied as a trial measure. Its utility was doubted as the gutterfly was not supposed to supply any plant food as it was considered to consist mainly of cotton fibres Evidently this opinion was based on an examination of cotton waste and not gutterfly. The presence of broken and entire cotton seeds in the gutterfly was not taken sufficient notice of. But chemical analysis later on showed that the gutterfly contained about 1 to 1.5 per cent nitrogen and hence was as valuable as farmyard manure in this important plant food.

In addition to the fact that gutterfly contains 1 to 1.5 per cent nitrogen, it is likely that its application to the land indirectly enhances the fixation of atmospheric nitrogen by supplying a readily available carbo-hydrate in the form of cellulose to the bacteria engaged in this process. This is analogous to the practice of the application of molasses to sugarcane in certain countries, which results in enhanced soil fertility.

The finely-divided organic matter which the gutterfly supplies, improves the physical condition of the soil very effectively. Light soils are particularly benefited by a liberal dressing of this material as it improves their water-holding capacity.

Unlike cattle-dung manure, gutterfly does not take a long time to rot. Given a fair quantity of moisture it rots completely within 8 to 10 days. It is so readily available that the residual effects of even a heavy application are not appreciable after 24 months.

A serious difficulty which is met with in the application of this material is that it cannot be incorporated with the soil easily unless after application the land is ploughed either with an inversion plough or a disc plough. Toothed and bladed implements are of no avail as the

gutterfly is collected into heaps by the former, while in the case of the latter the blades get choked and cultivation is impeded.

As all lands do not require ploughing every year, the use of gutterfly in the raw state becomes restricted. This difficulty can be obviated by rotting it in advance so that it can be incorporated with the soil easily.

Previous rotting of the gutterfly recommends itself on other grounds also. The raw material, while rotting in the soil, liberates a lot of heat which affects the germinating seeds and newly transplanted plants. Hence it is necessary to wait for at least a fortnight after sufficient moisture has been admitted into the soil to either sow or transplant. This means delay and loss. For instance, cotton suffers if sown late, and on land dressed with raw cotton waste or gutterfly sowing will be delayed. In the case of *jowar*, however, which is generally sown after the monsoon has well set in, the above difficulty does not arise.

On cotton lands it is not advisable to apply gutterfly for another reason. Along with the gutterfly, seeds of various varieties of cotton may be introduced thus damaging the purity of the type which is sown. Hence it is advisable to apply for cotton lands rotted gutterfly which is free from living cotton seeds.

On the College Farm, Nagpur for reasons mentioned above, gutterfly is not applied to land under cotton. The utility of this manure for cotton, however, as evidenced on the cultivators' fields, is certainly great in increasing the yield of *kapas*.

Areas meant for fodder *jowar* get a dressing of 3 tons gutterfly per acre. The tonnage of fodder obtained from such land has been three times the yield from the areas which get the usual farmyard manure.

On wheat land, 6 tons (12 to 15 cart loads) of raw gutterfly are applied during the hot weather and ploughed in. The yield of wheat on such land ranges between 1,100 and 1,300 lbs. per acre while the unmanured lands yield 550 lbs. per acre. If applied in August it would result in great benefit to the rabi crop, but the inaccessibility of the rabi fields during the rains restricts the adoption of this recommendation.

Flower beds are rendered rich, light and retentive by the application of gutterfly. If applied in the raw state, plenty of watering and

frequent forking of the soil are necessary for decomposition and proper incorporation with the soil before sowing or transplanting.

When applied as a top dressing, gutterfly should be applied in the decomposed form and well mixed with the upper soil. Decomposed gutterfly contains from 2 to 2.6 per cent. of nitrogen.

On the College Farm, Nagpur, the application of both raw and rotted gutterfly is done by means of the manure-spreading machine if the fields are big. In the case of small fields the carts conveying the gutterfly from the Model Mills are emptied directly on the fields and female labourers are employed for spreading it evenly.

A cotton seed defibrating machine has recently been designed by Mr. A. F. Yuill (*Agriculture and Live Stock in India*, Vol. I., pp. 607—617) and the trials conducted at Nanded show that it is quite possible to completely defibrate cotton seed before it is exported or used locally for various purposes. The advantages of defibrating cotton seed are also discussed in the same article. Mr. Yuill suggests a variety of uses to which the resulting waste product consisting of finely broken cotton fibre and broken cotton seeds could be put. The amount of waste product which results is estimated to be 18 to 20 per cent of the seed submitted for defibration. If defibrating cotton seed becomes an established practice in the cotton tracts, the amount of this gutterfly-like waste available will be enormous. Its utilization as manure will solve the problem of its disposal very satisfactorily.

SOCIAL LIFE AMONG INSECTS

BY K. R. SONTAKAY, M.SC.

IT may, at first sight, appear that insects which occupy a fairly low place in the evolution of animals, cannot be conceived as possessing a social organisation in any way comparable to the organisation of human societies. But a close study of social insects reveals that in certain cases their social organisation is so complicated that it even surpasses that of human societies. The respective colonies or cities of the insect societies consisting of a large number of individuals show very well how the interests of different members are concentrated towards the maintenance of the individuality of the colony. In short, individual interestsa re merged in the collective interests,

The incipient societies in insects are to be found among certain beetles and also in certain species of locusts. But the highly-evolved social instincts are developed amongst the Ants, the Social Wasps, the Bees and the Termites or White-ants.

Ants.—There are three distinct castes in an ant-community, males, females and neuters. Neuters may be further distinguishable into sub-castes. These are the soldiers, worker major, worker minor and worker minimæ. The function of the male is nothing else but to fertilise the female; that of the female or the queen to lay eggs eternally; that of the workers to tend the young, feed the queen, collect food and to look to the general welfare of the colony, and of the soldiers to defend the colony.

Swarms of winged males and females fly out for the nuptial flight. Cross-fertilization between different nests takes place. Queen-ants allow several males to mate with them one after another. Males then drift off to die of starvation. The females either return to their colony or found a new colony, lose their wings, lay eggs which develop into workers which assume the work of the colony.

Ants have a kind of patriotism which depends upon their sense of smell. Every nest has its characteristic smell and individuals emitting this smell are treated as fellow citizens. They have an economic life too, and this is based on direct exchanges of food.

The ways of life among ants are various and extreme. Certain ants keep domestic animals 'Aphids' which secrete honeydew which is licked by the ants. Then there are the agricultural ants which cut pieces of leaves which in the nest are turned into regular beds of leaf-mould for growing fungus on which the ants feed.

There is a species of ants known as 'Grain-collectors.' These are the celebrated soldier caste demilitarised. Mandibles or teeth are elongated like ploughshares—heavy, grinding and crushing tools which break up hard grains. Among the leaf-nest or the Tailor-ant child labour is employed. These make their nests among leaves, and if a hole is torn in the nest, the adults hold the young ones which when pressed secrete a thread which is used to stitch up the torn portion. Another interesting species is the slave making species Polygerus. These popularly known as Amazon ants with their long sickle-shaped jaws pierce the brains of defenders and carry away a store of cocoons. After emergence from the cocoons, these new ants serve their masters like slaves,

Bees.—Among the bees, there are three castes,—queen, males and workers. The work of the queen is to lay eggs, of the male to fertilise the queen and of the workers to gather nectar and pollen, to build cells of wax and to nurse the brood. In short, the whole work of a colony or hive devolves upon the workers.

The bee is essentially a creature of the crowd. If one isolates a bee and tries to keep it alive in captivity, providing it with its food, yet it will die soon.

Occasionally swarming takes place. There is a regular preparation in the hive from which a batch emerges. At this time, the hive is in a prosperous condition and the emigrants start off headed by the queen. The swarm at first alights at some spot, the scouts are sent forth to find a suitable place and then the whole swarm moves to the selected spot and a new colony is found. The workers prepare the cells out of wax which they secrete, the queen lays eggs and thus the hive grows.

When the reigning queen grows old, its place is taken by the young princess, and the old queen remains at some obscure corner of the hive but dare not face the young lest it be killed. When a foreign queen enters a hive, it is not killed by workers but by the legitimate queen. Workers will 'ball' it.

At the time of nuptial flight, hundreds of drones gather around the virgin queen. Twenty to thirty tribes will hasten from the neighbouring cities, her court will consist of more than 10,000 suitors and from these 10,000 one alone will be chosen.

When the hour of departure for the nuptial flight arrives, the queen appears on the threshhold and finally departs like an arrow to the zenith of the blue. Immediately clouds of males collect and follow her. The flight continues, the queen rising higher and higher, and ultimately one of the males connects with her. No sooner has the union been accomplished, than the male falls down dead. The queen returns to the hive and two days after, she lays the first egg and the process goes on her life time.

For the remainder of the summer, the busy life of the hive goes on as before. But one day the decree goes forth that those who do not work, shall not eat and indeed shall not live and the massacre of the

males begins. Vigorously and pitilessly the long-suffering workers at last turn on the drones and slay them all.

When the flowers become rare, days chill, bees sleep for the winter. A particular temperature is kept up, honey is passed on from individual to individual, the fire of life is kept glowing, ready to burst into flame again with the return of spring.

Termites or White-ants.—Their civilization which is the earliest of any, is the most curious, the most complex, the most intelligent and in a sense the most logical and best fitted to the difficulties of existence which has ever appeared before our own on this globe. From several points of view, this civilization, although fierce, sinister and often repulsive, is superioı to that of the bee and of the ant and even of man himself.

The termitary or nest of these insects is an engineering art by itself. These structures are built from within. Inside are the nurseries or fungus combs, elegant apartments and finally a royal chamber. The termites always keep a constant moisture and a steady temperature.

The castes of termites are the workers, soldiers and a royal pair—the king and the queen. The workers do all the work of the colony, feeding the inhabitants, repairing the nest, etc. They are responsible for feeding the whole population. Soldiers are armed with long jaws, they are more intelligent, have greater initiative and form on the whole a sort of fighting aristocracy.

The entire labour of reproduction devolves upon the royal pair. The queen's fecundity is proverbial and one egg every two seconds is the average. The lifetime of the queen is from four to five years.

Amongst these creatures, there occurs a phenomenon comparable to the nuptial flight of the bee. On a hot day after the rains, a large number of winged creatures emerge out of the termitaries which hover about for a while and finally lose their wings. Most of these perish but here and there a couple founds a new colony.

Normal regime in a termitary is monarchy but in case of necessity they keep two queens partitioned off in the same cell or as many as six royal couples. The constitution of the termitary is infinitely more accommodating, more elastic, more far-seeing, more ingeneous than that of the hive.

The social organisation of the hive is severe enough, but that of the termitary is incomparably harsher and more inexorable. In the hive, we find an almost total sacrifice to the gods of the city but the bee still retains a fragment of independence when she visits flowers. But, in the gloomy republic of termites, the sacrifice is absolute, supervision unceasing. Communism is carried to the limits of cannibalism.

But one great idea exalts them above us—a great instinct, a great automatic principle. I refer to their absolute devotion to the public good, their incredible renouncement of any individual existence or personal advantage, of anything that remotely resembles selfishness, to their complete abnegation, their ceaseless self-sacrifice to the safety of the state. In our community they would be regarded as heroes or saints. They practise the three most formidable vows of our severest orders, poverty, obedience and chastity, but in addition they perform the penance of darkness, and the vow of perpetual blindness which none of our ascetics or saints dare perform.

THE MENACE OF RATS TO AGRICULTURE

THE rat is a pest all over the world. It brings and perpetuates diseases like plague, eats away stored products, and destroys standing crop. In certain parts of the Punjab rats became such a serious pest that "the cultivators found it difficult to obtain a living, and were thinking of deserting their homes and fields." In the village of Jharauli in Karnal District rats destroyed in one year 80 per cent of the moth crop and 92 per cent of the millet crop, belonging to one Gajendra Sing Rais, causing a net loss of Rs. 785 on 296 *kanals* of land. A rat consumes about 6 lbs. of grain a year. The total rat population is in the neighbourhood of 800 millions and the loss caused to humanity by this pest is calculated to be in the neighbourhood of Rs. 22 crores.

During the last rabi season field rats caused considerable damage to standing crops in Berar and other places. In view of the possible recurrence of this pest in the future, the following methods of rat destruction will be of interest to agriculturists:—

(1) *Poison-baits* prepared with strychnine sulphate, arsenous acid and *Kuchla* seeds (Strychnos nux-vomica) have been found successful. The formulæ are given below:—

A.—(1) Strychnine sulphate	...	1 chhatak
(2) Sugar	...	5 seers
(3) Gram or wheat	...	40 seers

Strychnine is dissolved in 6 chhataks of warm water and a thick syrup of sugar is made by heating 5 seers of sugar in 1½ seers of water. Both the solutions are thoroughly mixed and then heated to ensure thorough admixture. This mixture is then sifted gradually on 40 seers of gram or wheat previously moistened. The poison is allowed to soak in the grains for some 12 hours. This should be sufficient for 1,300 burrows.

B.—(1) Arsenous acid	...	4 chhataks
(2) Sugar	...	1 seer
(3) Grains	...	15 seers

The method of preparation is the same as above. The quantity should be sufficient for about 480 burrows.

C.—(1) *Kuchla* seeds	...	2½ chhataks
(2) Sugar	...	2 seers
(3) Grains	...	15 seers

Kuchla seeds are cut in small pieces and boiled in water continuously for a long time to extract the poison. The rest of the process is the same as in the case of strychnine. The quantity should be sufficient for about 480 burrows.

All the burrows found in a field are seldom occupied by rats. The best method to ascertain which of the burrows are occupied is to close all the burrows one evening and those that are found opened in the following morning should be taken as occupied. Poisoned baits at the rate of half a chhatak per burrow should be poured well down such burrows, which should then be closed.

(2) *Fumigation.*—Calcium cyanide, carbon bisulphide and sulphur-arsenic or sulphur alone have been tried and found very effective.

Calcium cyanide is pumped with a "Foot-pump Duster" into rat-burrows. It liberates hydrocyanic ccid gas on absorbing moisture from the soil. Only a small quantity, about 2 tablespoonsful, is required for each burrow.

Fumigation is not a very practicable method in the black soils of this province which cracks and produces long furrows when rains stop. In such places poison baits will produce better results.

(3) This is a simple nevertheless very effective method for trapping field rats. Ordinary kerosene or petrol tins are used. The top is removed and the tin half filled with water. It is then sunk in the ground so that the open top will remain flush with the ground level and then lightly covered over with leaves and straw. While trying to reach the water the rat will fall in and would be drowned. On an average about 3 rats can be caught per tin daily. The tins should be removed to new places after a week and the water should be changed daily if possible.

[*For the recipes for baits and fumigation we are indebted to Rai Sahib G. R. Dutt.*]

Extracts

DAIRYING IN NEW ZEALAND—HOW THE FARMERS CO-OPERATE

By Boyd Cable

"IT is a complete puzzle to me why the British farmer either will not or cannot fall in with some co-operative scheme for the manufacture and marketing of his produce, because the same British farmer no sooner migrates to one of the Dominions than he eagerly accepts the co-operative movement, joins his "Co-operative," makes the fullest use of it, and gives every help to make it the tremendous success it is."

I had a first-hand experience a good many years ago of the working of the Co-operative system as the farmer dealt with it. I was doing a spell on a little farm where a good part of the land was rough hill pasturage for sheep and cattle and a small part was suitable for dairy farming.

We only had cows enough to give a milking of two or three cans of the size and shape in general use here. We were a good distance out from any town or market for the milk, and it certainly would not have paid to send a horse and cart and a man the best part of a day's drive in and out to sell so small a quantity. We did not have to.

We put the milk through the separator, kept the skim-milk to feed the calves and pigs, poured the butter-fat milk into the cans, carted these a few hundred yards down to the roadside, and left them there. From this point we were finished with the milk, were free to carry on with our own farming job, and left the Co-operative to take hold of our product and do the best with it. The factory lorry making its rounds picked up our full cans and at the same time dropped the emptied, cleaned, scoured, and sterilised cans from our last milking ready for us to refill.

At the factory, our little lot of milk was measured for quantity and butter-fat content, and the farm was credited with the value at the current price of the day, less a fraction set aside to meet possible fluctuation by the time the goods reached the market. At the end of the month the farmer received a cheque for the month's deliveries, and at the end of the season a further cheque was forthcoming for the fractions deducted if they were not required (as they seldom were) to offset any drop in market price.

The factory was one of a chain spread over all the dairying districts. Some of the farmers had their milk collected as we did, and others delivered their own to the factory. At regular hours you would see a stream of carts and lorries pouring into the built-up factory platform, where the full cans were offloaded and a batch of empty, clean ones picked up. The driver got a receipt for the amount of milk delivered, and rattled off in a haze of sun-lit dust back to his farmwork.

The Business Side

Here again the farmer was finished with his share of the work, and the Co-operative got on with the butter or cheese making, transport to the railway, shipment for export, sale over-seas, and collection of the cash. All that the farmer knew or cared about was how much milk he was getting from his cows, and what was the proportion of butter-fat in it. He very quickly knew of it if the butter-fat content fell below his average or the district average. He had this in the factory figures, and what is more he would very soon have a Co-operative expert on his doorstep asking what was wrong and offering skilled advice on how to improve matters by various means of stock feeding or breeding.

The usefulness of the Co-operative did not end here. If the farmer

wanted to buy anything, from a little milk separator to a full-sized milking and machinery plant, from a few sacks of chicken feed to whole tons of fertiliser, he bought from the Co-operative Association with which his own local Co-operative was linked and got the advantage of the lower prices paid by the Association because of its wholesale quantity purchasing power. He also received, in a bonus payment to members, his share of profits on the Association's whole business.

There are hundreds of these Co-operative factories throughout New Zealand, nearly all of them owned by the Co-operative Association, and therefore by the farmers who are its members. The many local associations are linked in a big central one which looks after exports and sales, deals with indents for supplies, has its agents or its own representatives in Home and other centres to look after the marketing and cable regular information about supply and demand which, if useful, is passed on to the farmer members concerned. If, for example, the agent reports a steady tendency of the London market to demand smaller-sized hams, that fact is reported and is passed on to the pig farmers together with the experts' advice on the class and kind of pig to introduce for breeding.

The local associations have representatives on the central one, and their annual meeting is in the nature of a farmers' council or parliament where difficulties and needs are discussed and a policy regarding them framed and passed out to all members.

Not only the dairying industry is organised in this way. The system applies to other branches, and is especially valuable in those like fruit, poultry, and pig farming, where many of the members are small holders who could hardly hope to carry on successfully if their organisation did not employ experts in the grading, packing, export and marketing of their products. The advantages are clear. The farmer is free to attend to his own specialised work of getting the most and best out of his farm, is financed by regular payments or advances on his produce, employs experts to handle and market his produce and gets back from his association all the profits which, without it, the middlemen would have made.

Is there any reason our British farmers should not do likewise? —*The Manchester Guardian.*

THE PINK BOLLWORM OF COTTON AND ITS CONTROL*

BY RAI SAHIB G. R. DUTT

DURING the last cotton season a good deal of damage was done to cotton by rains and insects. Out of the various insects which attacked the crop, the most serious was what is popularly known as the Pink Bollworm of Cotton (*Platyedra Sossypiella*, Saund).

The Pink Bollworn larva bores into the bolls, feeds on the seeds and spoils the lint. In the early stages of the crop when bolls are not formed, the larva attacks buds and flowers. The attacked buds and flowers drop off and so do many of the attacked bolls; those that remain on the plants, open prematurely and the fibre is short, dirty and comparatively useless. The oil content of the attacked seed is considerably lessened and the germination is also affected.

From the egg to the adult stage, the insect takes six to seven weeks; thus from the middle of June to the middle of December the pest can easily run through three or four generations. After the middle of December, the larvæ are found inside the cotton seeds where they continue as larvæ throughout the winter and summer months. They begin to pupate with the advent of the rains and moths emerge just about the time when the new cotton crop is coming up.

From the above, it will be clear that the pest is carried over from one cotton season to another in the infected cotton seed. If the infected seed is sown, subsequent infection of the resulting crop is certain. The remedy, therefore, is to destroy the "quiescent larva" in the seed before sowing. If, in the second or third week of May, the seed is spread very thinly in the sun, so that each individual seed may receive the full benefit of sun's rays for a couple of hours or so, all the larvæ resting inside the seed can be positively killed, and perfectly dependable insect-free seed obtained. It is very strongly recommended that this simple and inexpensive method should be adopted for treating all the cotton seed to be planted. This treatment should also be extended to all such seed as is intended for crushing or feeding if it is to be kept in store till after May.

The control is very simple and yet very effective. But to achieve the best results co-operation amongst cultivators is required. If a

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* From a leaflet published by the Department of Agriculture, C. P.

cultivator sows clean treated seed, he starts with a pest-free crop, but if his neighbour has failed to treat his seed, the latter's crop is sure to be affected by the pest, and some of the Pink Bollworm moths from his field are sure to fly into the former's field and attack his crop also. It is, therefore, hoped that cultivators will co-operate with each other in adopting this simple remedial method, and thereby not only save their own crop, but render material assistance to their neighbour's also.

PREPARATION OF CHEAP MANURES*

1. Method of Converting Bones into Phosphatic Manures

VARIOUS artificial fertilisers like ammonium sulphate, niciphos and superphosphate have been found to give good results with crops like cotton, sugarcane and rice. But, due to the present depression and fall in the prices of agricultural produce, the cultivators are not in a position to invest money on the purchase of fertilisers.

Various materials like bones, cotton stalks, pigeon-pea (*tur*) stalks, weeds, fallen leaves, etc., are usually available and the cultivators can convert these into useful and quickly available manures. A method for converting bones into useful manure is given below.

(1) The dry bones should be crushed as fine as possible in an ordinary mortar mill (*chaki*).

(2) Bone dust obtained from (1) above should then be mixed up with various ingredients and in the proportions indicated below:—

Bone dust	...	100 parts
Sulphur	...	25 parts
Sand (from riverbed or *nulla*)	...	100 parts
Water	...	20 to 25 parts
Charcoal	...	6 to 7 per cent of the weight of the mixed compost

Add enough cowdung, and soil from a fertile field to the water so as to make a fairly thick emulsion before it is sprinkled on the heap. The best plan will be to prepare a mixture of all the ingredients given above, except water, and then proceed to build up the compost heap of suitable dimensions by the addition of layers having a thickness of

* From a contribution to the *Hitavad*, by the Agricultural Chemist, C. P. and Berar.

about 9 inches to 1 foot each and to sprinkle the required quantity of the emulsion on each layer and continue the procedure till the whole of the mixture is composted. (In places where there is a scarcity of water, the raw products can be collected and kept ready during the summer, and the composting can be done during the rains.)

(3) The compost heap should be protected from excessive rain and sun by means of a thatched roof and should be kept on a floor which is firm and well rammed with stones. The heap should also be protected by side walls from the hot dry winds of the summer.

(4) After the heap is prepared as directed under (2) above, it should be left for a period of 6 to 8 months, care being taken during this period to keep up the moisture content at 20 to 25 per cent.

(5) If proper precautions are taken throughout the whole period of fermentation of the bones, a good compost which would compare favourably with superphosphate will be obtained after a period of 6 to 8 months.

In our province, bone composts, prepared according to this method, should prove particularly useful with rice, groundnut and cotton.

[*To be continued.*

RURAL UPLIFT WORK IN THE CENTRAL PROVINCES

A special campaign of rural uplift work was started by the local Government in 1929, as an experimental measure in the Piperia Revenue Inspector's Circle in the Hoshangabad District. The object was to concentrate the efforts of all departments connected with rural uplift for a limited period on this selected area and to ascertain how far such concentration would bring about permanent results. A special staff of an agricultural assistant, veterinary assistant surgeon and an assistant medical officer was appointed. Special assistance was also given by the Education and Co-operative departments and the work was carried out under the guidance of the Deputy Commissioner, Hoshangabad, and the Sub-Divisional Officer, Sohagpur. The results achieved during the last two years were very satisfactory and the work has now been extended to selected villages in the whole of the Sohagpur tashil.

The following extracts taken from the press note issued by the local Government dated the 2nd May 1932, show the main results achieved during 1931—32.

Agriculture.—The number of manure pits has risen from 1,770 to 2,968 and the practice of using cow-dung cakes as fuel is being steadily discouraged. The system of preserving cattle urine by the dry earth system has been adopted by 39 big cultivators in the tahsil. The use of sann-hemp manuring is being encouraged and the benefit of artificial fertilisers for garden crops is attracting attention. Three bulls have been purchased from the Powarkhera Experimental Farm for breeding purposes. There are now 16 Persian wheels in operation in the tahsil. Wire fencing by individuals and on co-operative lines is being advocated successfully, 147 rolls of barbed wire having been supplied. The more advanced cultivators are already exploring the possibilities of market gardening and horticulture. The demand for improved seed is increasing and 1,046 private seed farms have now an area of 9,662 acres under improved seed of wheat and other crops.

Veterinary Work.—The importance of injections and other preventive measures was demonstrated. The number of bulls castrated by the "Burdizzo" method increased from 309 to 1,783.

Medical and Public Health.—Over 200 lectures on sanitation and hygienic housing were delivered. Areas to be used for purposes of nature have been set apart in all the villages and in some the trenching of night-soil has been adopted. Every cultivator has now his own pit for refuse. The number of wells disinfected rose from 102 to 1,049. Medical relief was rendered to 10,598 patients as against 1,026 during the period November 1929 to April 1930. A system of private sale of quinine has been organised in 50 important villages. Other preventive measures included 577 anti-cholera inoculations, distribution of rat-poison and the medical inspection of school children. A child-welfare centre was started in the area in June 1930 and a "creche" system has been initiated in six villages.

Co-operation.—Twenty-two new societies have been organised, the total number being now 168, of which 164 are working and 17 are being re-organised. Twenty-nine rallies were held as against 9 in the first six months. A consumers' *adat* shop was started but has had to be closed down owing to fall in prices. A producers' *adat* shop has been organised, but has not yet commenced work. Uuder the auspices of the Piparia Co-operative Bank, night classes for the education of adults were started at 16 centres, of which 10 are still working. A beginning has been made with a fair measure of success in organising pig-killing societies and compulsory education societies.

Education.—The activities of the Deputy Inspector of Schools have borne fruit in the establishment of two new schools, the construction of a school building out of private subscription, the enrolment of 46 untouchable boys and 219 girls in the school and the formation of nuclei for village libraries. Every school has now its scout troop and there are in all 50 scout-masters and 505 scouts in the tahsil.

It is evident that the campaign has yielded concrete results, some at least of which are likely to prove permanent. In order to strengthen the foundation already laid, Government has decided to retain the special staff for another year. The total expenditure on the campaign from its inception up to date, including the pay of special officers, has been approximately Rs. 11,250.

Interesting experiments in a few selected villages are, however, in progress in the Nimar and Betul Districts and the ground has been explored on different lines in Amraoti, Bilaspur, Drug and Chhindwara (Seoni Sub-division).

Notes

THE CENTRAL PROVINCES COTTON MARKET BILL

It is gratifying to note that an atttempt is being made to establish organised markets for cotton in the Central Provinces on the lines of the Berar cotton markets. At present, cotton markets in the Central Provinces are constituted under the Municipal Act and they are controlled by the Municipal Committees generally drawn from amongst the trader classes. There is none to safeguard the interests of the seller or the grower in this committee with the result that they do not get a good price for their produce, and various unjust deductions are made from the price. The bill is intended to put a stop to all these malpractices and to help the grower to secure a fair price.

The bill gives power to the local Government to establish markets and to constitute market committees consisting of cotton growers, cotton traders and representatives of local bodies. The inclusion of the cotton grower in the committees is a very wise step and it is the complete exclusion of this class from the committees that constitutes the chief defect of the Berar markets.

The local Government is given power for making rules regarding the composition of the market committees and the management of the affairs of the market. The opening of private markets near these markets is prohibited.

Dharmadaya and other deductions are declared illegal and punishable with fine. The weighmen will, in future, be the servants of the market committee and not of the buyer as at present.

We hope that this bill will go a long way to establish fair dealings in the markets.

NEW SOUTH WALES RICE MARKETING BOARD

Ten years ago Australia was an importer of rice. To-day she is a seller in the international market. This rapid development of the rice industry in New South Wales is an interesting example of what marketing organisation can do to develop production. The marketing of rice is in the hands of a statutory board which controls the purchase and sale of rice in New South Wales.

The Board assembles the rice at its own depots, makes advance payment to suppliers at the time of delivery and disposes of the crop later by co-operation with well-established millers. The Board has now succeeded in establishing markets for its rice in several countries. The Board is also trying to develop the home market by encouraging home consumption and for that reason has published a booklet of Recepees for Rice dishes. The Board has appreciated the intimate connection between production and marketing problems. By co-operation with the agricultural and irrigation departments, it has brought to producers the most up-to-date knowledge on varieties of crops, preparation of the land and other cultural matters.

THE RICE RESEARCH SCHEME

The Imperial Council of Agricultural Research is organising a Rice Research Scheme in India. Research stations will be established in all important rice tracts to study problems concerning the cultivation of rice, a crop that has so far been neglected although it is the most important food crop in India, occupying nearly 80 million acres annually. The Empire Marketing Board has offered a subsidy to the

scheme. We understand that Raipur is going to be one of the Research stations and that steps are being taken to start the work during this season. We hope this will provide a stimulus to the improvement of the rice crop in our province.

COST OF PRODUCTION OF CROPS

Under the joint auspices of the Indian Central Cotton Committee and the Sugar Bureau, an enquiry will soon be started on the cost of production of crops like cotton and sugarcane. This is a line of enquiry which is long overdue. No reliable information of any kind is available regarding the cost of production of crops in India. It is usual for the settlement officers to calculate the cost of producing the various crops at every resettlement in order to arrive at the producers' surplus on which they base their assessment. But these estimates are always liable to criticism. A correct estimate of the cost of production is no easy task in India where cultivators keep no accounts of any kind. All interested in agricultural economics are looking forward to the fruits of this enquiry which, we hope, will prove very valuable.

COTTON CONTROL BILL

A bill with this title is proposed to be introduced in the Madras Legislative Council shortly. The object of the bill is explained thus :— The quality and the reputation of the *Karunganni* cotton which is the special feature of the Tinnevelly area and which plays a prominent part in the economic prosperity of the cultivators in that area on account of the great demand for this cotton, are being threatened by the admixture of other cottons, in particular, G. neglectum (*Pulichai*) both in the field and in the factory. In the draft bill, it is proposed to take power to notify, from time to time after sufficient notice to the cultivators, all kinds of cotton that may, in the opinion of Government, require to be proscribed. Power is also proposed to be taken to uproot the proscribed cotton plants cultivated in fields and seize cotton found elsewhere in the notified areas. Provision has been made for the examination and analysis by experts of the cotton seized, before launching prosecution. The usual clauses for making the necessary rules are also added.—*The Madras Agricultural Journal.*

LAND FOR THE EDUCATED UNEMPLOYED

An A. P. I. message to the Madras papers states that Dr. G. T. Hongorani, President of the Karachi Hindu Mahasabha, has initiated an interesting scheme for the relief of educated unemployed persons in Sind, whereby some Zamindars have agreed to give eight to fifteen acres of land, together with seeds, bullocks and implements for cultivation to each such unemployed person, who will be entitled to half the earnings from cultivation, the other half going to the Zamindar. An important condition is that the men should be prepared to do all the necessary manual labour. The message adds that twenty-five youths have accepted the offer and are proceeding shortly to settle on lands near Jacobabad, Larkana, Nawabshah and other towns.—*The Madras Agricultural Journal.*

SUGAR PRODUCTION IN INDIA DURING, 1930—31

Twenty-nine factories making sugar direct from cane worked in India during the season 1930—31 as against twenty-seven in the previous season. Eleven of these are situated in the Province of Bihar and Orissa, thirteen in the United Provinces, one in Bombay, two in Madras, one in the Punjab and one in Burma. A new factory in the Punjab started working during the season under report.

The production of sugar direct from cane by factories in India totalled 3,262,574 mds. or 119,859 tons during the season 1930—31 as against 2,443,486 mds. or 89,768 tons during the previous season. There was thus an increase of 819,088 mds. or 30,091 tons in the output of sugar during 1930—31 as against 1929—30.

The average percentage recovery of sugar in India also shows an improvement, having risen from 9.07 to 9.09 in 1930—31. It is gratifying to note that the general efficiency of the factories making sugar direct from cane is steadily increasing. Out of the 29 factories that worked in India during the season 1930—31, the percentage recovery of two factories is above 10, of twelve factories above 9, of eleven factories above 8 and of only four below 8.

During the season 1930—31, India's production of molasses by modern factories making sugar direct from cane totalled 1,311,652 mds. as against 963,387 mds. in 1929—30 or an increase of 348,265 mds. over the previous season.—(*Agri. & Live Stock in India*).

INDIAN MANGOES FOR THE ENGLISH MARKET

It was recently reported in the papers that a few consignments of mangoes were sent to England from Bombay as an experimental measure to explore their prospects in the English market. The experiment was undertaken by the Bombay Fruit Growers' Association under expert guidance from the Bombay Department of Agriculture. If the consignments reached England in good condition, a portion was first to be presented to His Majesty the King. The experiment is a very interesting one and, if successful, will have far-reaching effects on our fruit industry. There are several fruits in India worth putting on foreign markets. The Nagpur Santhra is one. The behaviour of these pioneer mangoes will be watched with great interest in India and we look forward to a report on the same before long.

Since writing these lines information has reached India that these consignments stood the journey very well. The Empire Maketing Board has reported very favorably on these mangoes which were sold in the markets at rates varying from 1 to 2 shillings each. It costs roughly 7 annas to send a mango to England but the profit is about 11 annas on each mango.

Investigations by the Lister Institute have revealed the fact that the mango is the richest known source of Vitamin C and is also well supplied with Vitamin A. Thus the prospects seem to be bright for a brisk export trade in mangoes from India.

College News

AFTER a brief holiday of about ten weeks we re-assembled again on the evening of the 9th June to pursue the course of studies we have undertaken. Regular work began on the morning of the 10th with a general assembly of all the students which the Principal addressed. In a short and impressive speech, the Principal welcomed the students back to the College and outlined the various changes that have taken place in the College Staff. He also made a brief reference to the economic crisis which has cast its shadow upon the whole world and appealed to the students to help their parents to tide over the situation in the first place by economising expenditure and, secondly, by passing

their respective examinations every year. We hope that the students will bear the advice in mind and carry it out in the spirit in which it was given.

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Several changes of a far-reaching character have taken place in the College during the course of the last three months. Mr. R. G. Allan whose association with the College dates back to its very inception, left us in March when we were very busy with our examinations. Mr. Allan's place has been taken up by Mr. J. C. McDougall, M.A., B.Sc. Mr. McDougall is not altogether a new person to us. He was with us in 1929 when Mr. Allan was on leave and during a short period of nine months or so, he had endeared himself to the students and staff by his qualities of head and heart. Since then, he has always kept up his interest in the College and he would never pass by a student without a smile or a sincere "How are you getting on"? We are glad to have him as the head of our institution and we hope that with his ability and profound knowledge of men and matters, he would be able to raise this College to a still higher degree of efficiency and usefulness.

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The teaching staff of the College has also undergone some changes. The services of Mr. S. B. Karkarey, our Lecturer in English, were terminated with effect from the 15th of June. Mr. Karkarey was with us for nearly seven years and was very popular amongst the students. We are sorry to lose him and we wish him every success in the legal profession to which he originally belonged and to which he has now returned.

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With great pleasure we welcome to our midst Prof. Nascar, Prof. Vaidya and Prof. Mitra of the Science College who will, in future, take our English classes. Our friends in the Science College hold them in great esteem not only for their professorial talents but also for the great interest they take in the social life of the students. We do hope that they will extend the same sympathy and cordiality to us.

* * * *

We heartily congratulate Mr. K. R. Sontakay on his success in the recent M.Sc. examination in Zoology. Mr. Sontakay took Entomology as his special subject in the Final M. Sc. We are sorry to hear that his extended knowledge of the subject and his experience in teaching will

not be available to us for long. Mr. Sontakay took a keen interest in all social activities of the College and he was very popular with the students. Last year he rendered valuable help to our representatives in the Inter-Collegiate debate. We shall miss him much. We wish him all success in whatever sphere he enters.

* * * *

Mr. R. J. Kalamkar, an old boy of our College, has returned to India after a brilliant career in England. He is the first B. Ag. of the Nagpur University and, on taking his Degree in 1929, was awarded the King Edward Memorial Scholarship for statistical studies in England. Mr. Kalamkar worked at Rothamsted under Dr. Fisher for two and a half years and has recently obtained a Ph. D. from the London University. We are proud of the achievements of Dr. Kalamkar and wish him all success in life.

* * * *

The King's Birthday Honours list has brought honour to our College also. Mr. G. R. Dutt, B. A., our Entomologist, has been made a Rai Sahib in recognition of the valuable services he rendered at Pusa and at Delhi. Our felicitations to him and we wish him still higher honours.

* * * *

Our sincere thanks are due to Mr. P. D. Nair, M.A., L. Ag. (Hons.), for the help he has rendered in getting out this issue of the magazine. We hope that his able guidance and supervision will always be available in the future and that our College magazine will soon become a more useful journal with a much wider circulation.

* * * *

Hostel News

OUR Hostel is once again a busy hive of toiling students. The appearance and equipment of the hostel have undergone much change but the nuisance of the pail depot is still there. We hope that the authorities will take steps to remove this ugly spot from the centre of many educational institutions and activities.

* * * *

Our common room and recreation rooms are very popular amongst the students. But they lack in good furniture and other requisites. We hope that our kind and sympathetic Principal will look into this matter soon.

* * * *

A students' supply store is an important and necessary adjunct to all educational institutions. Apart from its educative effect in inculcating thrift, self-help and other desirable qualities in young men, it is a great convenience to have students' requisites available within the college precincts. It saves a lot of time and is very important from the point of view of agricultural students who are busy with their class work from sunrise to sunset and, more than all, it saves them from the temptation of squandering their money on the fashionable trinkets of modern days, so alluringly exhibited in our shops. We hope some of our adventurous friends will make a move in this direction.

* * * *

There seems to be plenty of musical talent in the hostel, both instrumental and vocal. In the evenings one hears music of all kinds pouring out from every room. There seems to be great scope for the formation of a musical society. Our Hostel Superintendent is himself a great musician and shall we not hope that he will give a helping hand in the formation of a musical society? Our imagination takes a sudden unrestrained flight and we see before our eyes happy evening parties of musicians with Harmonium and *Tambura* and *Tabla*, pouring out their music with "full-throated ease," and a happy bunch of young men squatting around and nodding their heads in blissful oblivion!

* * * *

We congratulate Mr. Z. A. Khan on his election as the Secretary of the Hostel Reading Room and Library. The Library has been recently enriched by a gift of books from Mr. R. G. Allan and Mr. L. ~~N.~~ Zhay. Our heart-felt thanks to these gentlemen for their valuable gifts.

* * * *

We extend a hearty welcome to the freshers. We hope that amongst these bright looking boys there are potential genuises who will bring credit and honour to our College.

The College Gymkhana

EXTENSION of the gymkhana ground which has been long under contemplation has been started. The pavilion has been shifted back about 30 yards from its old site. When the extension of the ground is completed it will no longer be necessary to delay hockey practice for want of dry ground, as with the acquired area the main ground will be big enough to permit both hockey and football games to be played simultaneously.

A third tennis court is nearing completion and will supply a long-felt want, as tennis is the most popular game, But it is hoped that this facility will not diminish the enthusiasm of the students for more manly games like football, cricket and hockey.

The following have been elected secretaries for various sports for 1932—33.

Hockey	Mr. M. M. Khirey
Cricket	Mr. G. N. Deshpande
Football	Mr. Shariful Hussain
Tennis	Mr. R. N. Kher
Volley Ball and Indoor Games ...	Mr. S. S. Ambadekar
General Secretary	Mr. D. Mishra.

We offer our hearty congratulations to the above-mentioned gentlemen and hope that they will turn to good account the improvements mentioned above.

Examination Results—1931-32

FIRST YEAR PROMOTION EXAMINATION

(In order of merit)

1. V. G. Vaidya
2. A. B. S. Verma
3. R. D. Mukerjee
4. Biswanath Sahu
5. K. G. Joshi
6. Damodar Patnaik
7. Haribans Mishra
8. Syed Mazhar Ali
9. K. S. S. Chauhan
10. V. S. Hingankar
11. N. V. Bapat
12. H. R. Shrivastava

13.	N. W. Tilloo	24.	G. W. Pitale
14.	B. R. Dutt	25.	K. R. Chande
15	V. D. Taparia	26.	T. N. Puranik
16.	M. L. Chaubey	27.	K. M. Kapte
17.	G. M. Bawsay	28.	P. B. Bhumralkar
18.	Y. K. Dabhadkar	29.	H. A. Kaiyumi
19.	H. N. Basu	30.	R. S. Harkare
20.	B. S. Venugopal Rao	31.	S. G. P. Tiwari
21.	S. A. Rasheed	32.	T. M. Koyal
22.	Shariful Hussain	33.	R. L. Gupta
23.	S. N. Walkade		T. P. S. Chowdhary*

INTERMEDIATE EXAMINATION IN AGRICULTURE
NAGPUR UNIVERSITY

1.	Abdul Mbin Chowdhury	Second Division
2.	Damodar Misra†	do.
3.	Harihar Mishra...	do.
4.	Laxman Bhauji Deshpande	do.
5.	Mohd. Zafar Ali Khan	do.
6.	Prabhakar Vishnu Bhagwat... ...	do.
7.	Pralhad Tiwary	do.
8.	Ganesh Chandra Baruah	Third Division
9.	Mahadeo Madhao Rao Khirey ...	do.
10.	Narayan Puroshottam Konher ...	do.
11.	Pulimood Mathai Joseph	do.
12.	Bhagwati Prasad Dwivedi	Pass
13.	Dinanath Gour	do.
14.	Ganpati Laxman Deshkar	do.
15.	Sadashive Kashinath Dharmadhikary ...	do.
16.	Shankar Lal Nema	do.
17.	Shriram Shioram Ambadekar ...	do.
18.	Krishna Bhaiyaji Rahurkar... ...	...

Compartmental Passes, and to appear in the subjects noted against each.

1.	Narayan Narhar Bhide ...	Agricultural Mathematics and Engineering
2.	Pandurang Narasinva Soman ...	do.
3.	Sarojendu Kumar Datta ...	do.
4.	Sohanchand Bhandari ...	do.
5.	Umashankar Sakharam Upadhya	do.

* This student was absent from the examination on account of sickness but was promoted on his class record.

† Awarded the Sir Arthur Blennerhassett Memorial Medal for standing first in the Intermediate examination.

THIRD YEAR PROMOTION EXAMINATION

(In order of merit)

1. S. C. Bhattacharya
2. N. P. Deshmukh
3. E. D. Pimplikar
4. S. L. Vishnoi
5. H. P. Dwivedi
6. H. K. Das
7. H. K. Sen
8. P. S. Dutt
9. S. B. Vaidya
10. R. N. Deshpande
11. N. B. Chincholkar
12. H. S. Dhalloo
13. L. P. Khare

14. { R. L. Singh / J. G. Bhalerao }

16. { M. K. Nagmoti / Mohd. Ishaque }

18. R. N. Kher
19. S. A. Rahman
20. B. M. Chandel
21. H. P. Mishra
22. G. N. Deshpande
23. D. C. Kelkar
24. N. K. Ghosh
25. L. B. Deshpande
26. J. P. Tiwari
27. Mohd. Akram
28. B. P. Rawat

Gleanings

Iodised Eggs.—Attempts have been made in American and German poultry farms to produce eggs containing a high percentage of iodine which can be assimilated far more easily by the human system than when the drug is administered direct. Mrs. Janosi, a poultry farmer near Budapest, has now succeeded in producing eggs which contain 0.169 milligramme of iodine without any perceptible bad taste. Her achievement is regarded as very important and it was recently published in a special edition of a German medical journal. Iodine egg cures will not be available and persons who are unable to digest the medicament, may benefit from it without discomfort. —*The World To-day.*

Smoking made Harmless.—Tobacco is a native of Central America. It was introduced into Europe sometime in the 16th century. The Portuguese are said to be responsible for introducing this vicious drug into India. Several attempts were made to prohibit the use of this drug by Royalties all over the world. King James I of England issued his famous "counterblast" in 1603. Emperor Jehangir is said to have forbidden its use in his dominions. Yet

there is scarcely a tribe or people in existence which does not use it. The world smokes over 2,000,000,000 pounds of tobacco every year. Nicotine, the chief substance in tobacco, is a deadly and dangerous poison. When young people smoke tobacco, it arrests their growth and makes them weaklings. In view of the spreading fashion for smoking amongst students the production of a necotine-free tobacco is to be welcomed. "The Tobacco Research Institute of Forchhain, Germany, finds that the nicotine content of certain varieties can be governed by cultivation and fertilization. With close planting and regulated watering nicotine was entirely eliminated."

Loss to Agriculture due to Insects.—At the conference of Empire Entomologists held in London in 1930, it was stated that in Canada losses due to insects to field and fruit crops and forests had been estimated at £30,000,000 per annum. In Queensland these losses were estimated at £2,000,000, including damage to cattle industry. For the Indian Empire the loss to Agriculture including that in domestic animals and animal products was estimated at £15,000,000. We really want able entomologists who would save us from these staggering losses.

Vegetable Meat from Cotton Seed.—Dr. Wessen, an American expert on cotton seed and other vegetable oils, announces adiscovery of considerable interest to India. Nutrition is the most vexed problem in this country. Our food is insufficient and lacks in nourishment. Dr. Wessen announces a nutritious and cheap meat substitute made from cotton seed—a commodity we have in plenty in this country. "It is a sweet almost tasteless flour-like body which will keep as well as wheat flour. It carries 50 to 60 per cent protein or two and half to three times as much as is found in meat and available for human food. When properly prepared it is palatable and nutritious. It not only can be, but has been eaten by many persons since it was first prepared. When mixed with vegetable shortening and water to simulate meat, a meat substitute costing about 5 cents a pound can be produced. It can be used in hash, coquettes, meat-loaf, sausages, sandwich fillings and so on. Such a product would be a boon to the poor. The cotton crop contains enough protein to meet the needs of more than 50,000,000 persons."

A new Source of Sugar.—Some recent experiments show that Jerusalem artichoke is a source of sugar much sweeter than is obtained from cane or sugar-beet. These artichokes will grow on almost any kind of soil and their leaves make a good feed for cattle. It is expected that the Irish farmers will soon take up the growing of this vegetable.

What is a Cloud-burst ?—Rain falls during rainfall but clouds do not burst when there is a "cloud-brust." United States Weather Bureau experts say that sometimes strong upward currents of air hold rain drops up from underneath and prevent them from promptly reaching the ground. Then the drops gather in much larger quantities than they usually do. When the upward air currents lessen or so much water accumulates that the air cannot supprot it there occurs the deluge of rain that we call a cloud-burst—*Scientific American.*

Smell of Apples Discourages Sprouting of Potatoes.—Apples make the ideal companions for potatoes in storage, according to a report by Dr. O. H. Elmer of the Kansas Agricultural Station in a recent issue of "Science." Dr. Elmer's experiments revealed that potatoes stored with apples through the winter, remain firmer and show less tendency to sprout than do potatoes stored alone. He attributes this to the volatile substance given off by apples having apparently established the fact that potatoes will not sprout as long as they can "smell." Apparently only ripe apples will do the trick for Dr. Elmer's experiments seem to indicate that neither green apples not rotten ones have any discouraging effect on the tubers. Neither have other fruits that he tried, including oranges and Benanas—*Scientific American.*

Wood Farming.—Here is a tip for our *malguzars* and owners of big estates having plenty of forest lands. *Farmers' Bulletin No. 1680-F.* of the Department of Agriculture, U.S.A., cites almost a score of cases where farm timber cropping has yielded good returns. "One farmer in Indiana, for example, reports that he sold 700 dollars worth of forest products, built five farm buildings, and supplied posts and cardwood from a 20-acre tract he had acquired in 1900 just after it had been cut over. By 'farming' the woods he had a good stand of timber left for which he was offered 3,000 dollars. Another farmer supplied his farm with fuel for 17 years and produced 16,000 board feet of construction timber from a half-acre tract. Of all the arguments that might be advanced in support of such planned cropping of the farm wood lot perhaps the most cogent is the promise it holds out to the farmer of annual profits. The evidence gathered proves that profits can be made. By cropping his woods as he does corn; by cutting out the weak trees and the unhealthy and crippled ones so that the best trees have a chance to develop properly; and by cutting the good trees only when they are fully 'ripe,' the farmer may not only earn a cash dividend each year on loafing acres but may also enhance the value of his farm."—*Scientific American.*

Sterilizing Milk with Sound Waves.—Milk and similar liquids may, some day, be sterilized by subjection to a " terrific squeak " instead of by heat treatment. This possibility is visioned as a result of experiments by Dr. Leslie A. Chambers and Prof. Newton Gaines of Texas Christian University, at Fort Worth, Texas. The apparatus which they have constructed and used in their laboratories, averaged a kill of 80 per cent of all bacteria present in various samples of milk, and in a few samples it produced complete sterilization.

The sound-wave treatment, however, does not destroy bacterial spores; but such spores are also immune to pasteurization. Fortunately for both methods the real trouble-making germs in milk are not spore formers. —*Scientific American.*

Frozen Fruit Pulp.—Experiments in the food-research division of the Bureau of Chemistry and Soils, United States Department of Agriculture, have developed a new type of frozen fruit pulp which promises a new outlet for the fruit-grower and packer, a new fruit base for the ice-cream manufacturer and soda-fountain operator, and a new product for direct consumption in the frozen state. By pulping the pitted fruit, adding a sugar syrup of proper concentration, mixing it thoroughly and then freezing at a very low temperature, chemists have developed a product with a remarkably smooth texture and full retention of the original flavor. Experiments have included peaches, apricots, plums, cherries, pears, raspberries and strawberries ".—*Scientific American.*

Soy-beans as Human Food.—Nearly half of the world's total population uses soy-beans daily as a pretein food, replacing meat. A hundred generations of Chinese have been raised on this source of protein, and Dr. Horvath called this one of the world's most extensive biological experiments. Its protein or meat-like constituent, is extremely well balanced, containing some necessary amino-acids that milk and meat do not provide. Forty per cent of the soy-bean is protein while 20 per cent is oil. It contains all the vitamins and counteracts acids within the body. Dr Horvath explained that one pound of soy-beans costing wholesale, two cents, contains as much protein and fat as two pounds of beef. A new Austrian process is now being used to remove the beany taste from soy-bean flour and make it suitable for wider general use.—" Science news letter," *Allahabad Farmer*, January 1932.

Cotton Picking Machine.—" A money-saving machine, which the Labour Department says will do in less than three hours the work that used to take one man 77 hours, is ready to take its place in the cotton fields. Mechanical experts of agricultural experiment stations declare that practical perfection

of cotton harvesting machinery has arrived. Not only has the machine for picking arrived, but the cotton gin has been more fully perfected to prevent loss of quality by machine picking. The department said that the labour saving represented by the new machine, is a net gain for the cotton farmer." —*Scientific American.*

Current Research

Some Factors concerning Earliness in Cotton.—(C. P. Ludwig. *Journal of Agri. Res.*, Vol. 43, pp. 637—59). The pro-duction of an early maturing variety of cotton will be one of the ways of circumventing the Mexican Boll-weevil in U. S. A. The following topics have been investigated (i) Varietal differences in the maturation periods of squares (blossom buds) and bolls; (ii) Effect on the maturation periods of the time of application of nitrogenous fertilizers; (iii) Effect of the amount of nitrogenous fertizers applied; (iv) Effect of the spacing of the plants; (v) Effect of duration of cultivation; (vi) Effect of stripping the forms and; (vii) The rate of development of the bolls. The boll maturation period, of Upland varieties of cotton appear to be shorter in general than those of Egyptian or Sea Island. In the matter of the boll period the evidence does not indicate any influence due to the time of application of the nitrate, neither the amount of nitrate applied as fertilizer nor the time of application had a perceptible effect on the square or boll period. Variations in the spacing of the plants had no appreciable effect on either the square or boll period except possibly a slight shortening of the boll period in wide spaced plants which was masked by the result of other influences. The usual cultivation period and a lengthened period produced an increase in square and boll period over no cultivation—Stripping forms (*i.e.* either squares or bolls) from the plant had no perceptible effect on the equare period.

Studies of Lignin in Wheat Straw with Reference to Lodging.—by Max Phillips. *Journal of Agri. Res.*, 1931, Vol. 43, pp. 619—626. Lodging, or the lying over of cereal plants when their vegetative growth is nearly complete, has considerable consequences on agricultural practice. There are various theories regarding the cause of lodging. Some writers thought that the ability of grasses to stand erect depends upon their silicate contents and a deficiency in this caused lodging. Others attributed lodging to several causes among which deficiency of lignin in the culms of the plants is one. The present

investigation was undertaken to test the accuracy of these views. Experiments were conducted on two plots, one manured with sodium nitrate and the other unmanured, serving as control. The lignin, methoxyl, cellulose, silica and ash content were determined in wheat stalks cut at various stages of growth from fertilized and unfertilized plots. Wheat stalks from plots which received sodium nitrate and where lodging had occurred in nearly all cases contained a higher percentage of methoxyl and lignin than did the stalks from the plots which received no nitrates and where no lodging had taken place. The cellulose was also greater except in the last stages of growth in the stalks from the plots where lodging had occurred than in the stalks from the plots where the plants did not lodge. These results disprove the theory that lodging was caused by a deficiency by lignin. In the early stages of growth the ash content was higher in the stalks from the fertilized plot (lodged) than in those from the unfertilized plots (not lodged) but in the later stages the relation was reversed. Sodium nitrate caused a distinct decrease in the silica content of the straw. The result on the silica content of the straw seem to furnish new evidence in support of the view that lodging was caused by a deficiency of silica in the straw.

Some Recent Developments in connection with Cotton Seed Disposal.—A. F. Yuill *(Agri. & Live Stock in India*, 1931, Vol. I., pp. 607-17.). The advantages of completely removing the short fibres that are attached to the cotton seed are many. Transportation becomes cheaper, the seeds will contain a higher percentage of oil, extraction of oil is more perfect and the resulting oil cake will be richer as a cattle feed. Sowing of such seeds will also be easy as the tendency to collect into bunches is eliminated. The Hyderabad cotton-seed defibrating machine designed by Mr. A. F. Yuill of the Hyderabad State service has been tested thoroughly at Nanded during the last cotton season. The results are very encouraging. The seeds are 100 per cent defibrated. In the case of some varieties, there has been a certain amount of breakage of seed. On an average 100 lbs. of fibrated seeds gave 80 lbs. naked or defibrated seeds. The capacity of the machine experimented with is limited as it is capable of dealing with only 140 lbs. of fibrated seeds (1 bag) per hour. But it is hoped that bigger machines of 5-cwt. capacity and requiring 20-H. P. energy will be manufactured in the near future. The writer suggests a variety of uses for the bye-product.

[*In the light of experience gained on the Agricultural College Farm, Nagpur, with "gutter fly" or "blowroom refuse" about which an article appears in this magazine, the "crude fibre and dust" obtained during defibrating cotton seed may be profitably used as manure.*—Editor]

The Importance of the Shape of Plots in Field Experiments.—Basil G. Christidis (*Journal of Agricultural Science*, Vol. 21, part I, pp. 14—37, Cambridge, 1931). In agricultural experiments it seems that significant results cannot be secured by only using appropriate statistical methods; uniformity amongst the individual plots is more essential than anything else. 2. Some theoretical considerations suggest that the shape of the plots constitutes an important means of controlling soil heterogeneity. In accordance with these: (*a*) in no case can square plots be more uniform than long and narrow ones; (*b* the smaller the value w/l the more uniform the experimental plots, and (*c*) since uniformity depends (apart from w/l) on the value of the angle "a" in some exceptional cases 'soil fertility varying gradually and evenly, and angle "a" approaching 90°) the advantage of the long plots may be less than would be anticipated. This, however, is most unlikely on account of the complexity of the variation in soil conditions and the possibility of easily avoiding such a critical value of the angle "a". 3. In order to test the validity of the assumptions made regarding the effect of the shape of the plots, the numerical data of several uniformity trials have been considered. A close agreement was found between expectation and actual results in the great majority of cases the evidence being remarkably significant in favour of the long plots. In only three cases, were the results inconclusive, this apparently being accounted for by the way in which the original plots were formed, causing an inequality in area amongst them. 4. In the light of these investigations, in order to reduce the effect of soil heterogeneity, the plots used should be as long and narrow as possible. This, of course, within the limits set by different practical considerations, amongst which convenience, competition (when acting), and the accurate measurement of the width appear to be the most important. (Abstract from *Agri. and Lives Stock in India*).

Effect of Mosaic Disease on the Yield and the Juice of Sugarcane in Pusa in 1931.—(W. McRae. *Indian Journal of Agri. Science* 1. 527). Though in tropical lands noble canes infected with mosaic disease show a great reduction in tonnage and considerable reduction in available sucrose, yet, with the exception of Hemja, the thin canes of Northern India that are infected, do not show striking reductions of this kind. Eye observations of the standing cane does not reveal any marked difference in tonnage though there is a belief in the mill that the available sucrose is reduced. In Pusa for the last year or two, the amount of spread in the growing crop has been small so conditions seemed fo be favourable for a field-experiment consisting of a series of adjacent pairs of plots of mosaic-infected and mosaic-free cane. In 1930 accordingly plots of Coimbatore Seedling Canes Co. 213 and Co. 215 were laid down so that differences could be more accurately determined. The former is the cane that

has found favour in the white-sugar tract of North Bihar and Co. 205 was a good cane for the poorer class of land though it has fallen now into disfavour because of its high fibre content. The mosaic-infected cane was taken from plots wholly infected with the disease and setts were cut from canes whose leaves showed mosaic markings at the time of harvest. Thus there was no doubt about the cane being infected. The mosaic-free cane was taken from plots that were frequently observed during the growing season and were found to be entirely free from the disease and setts were cut from canes that at the time of harvest had no mosaic markings on their leaves. Thus the cane was definitely known to be mosaic-free when planted. The area in which Co. 213 was planted, was good, even, heavy land suitable for growing cane while that in which Co. 205 was light high land, rather lighter than is considered good for cane but it was the only site available seeing the main cane area had to be protected from the disease. There was extremely little damage done by other diseases or by insects and animals so in these respects the experiments were wonderfully fortunate. During the season, a small amount of infection spread to the mosaic-free plots. In the case of Co. 213 it amounted to 0.1 per cent and of Co. 205 to 0.7 percent. These amounts are far too small to have any appreciable effect on the yield. It is indeed this low rate of spread that has rendered the experiment practicable in its present form. After leaving out sufficient cane round each plot to eliminate edge effect, the 10 pairs of plots were each 150 by 21 feet in the case of Co. 213 and the eight pairs of plots were 120 by 12 feet in the case of Co. 205. The mean average weights of stripped cane in maunds were :—

		Mosaic-free.	Mosaic-infected.	Deficient.
In Co. 213	...	48.80	46.55	2.2 or 4.6 %
In Co. 205	...	8.53	7.79	.74 or 8.6 %

Thus the reduction in tonnage is comparatively small. With regard to the juice it became evident that equal weights of mosaic-infected or mosaic-free cane produced equal quantities of juice, and that in Co. 213 the sucrose and purity were slightly reduced while the glucose was higher bnt in Co. 205 the differences were too small to be significant. These results may be taken as applicable to Coimbatore seedling canes in North Bihar and the adjacent tracts of the United Provinces but they may or may not be applicable to the rest of Northern India. Experiment alone in several places can settle this point. The conditions in South and Western India are so different that these results can hardly have any value there and it is possible and perhaps likely that greater losses may occur both in tonnage and quality of juice.—(Summary from *Agri. and Live Stock in India*, Nov. 1931).

Calf Rearing.—By E. J. Sheehy, *The Farmer's Gazette*, January 17, 1931.—Disorders of the food tube, which culminate in scouring or diarrhœa and their accompanying ill-effects, are, during the early weeks of the calf's life, frequently due to the feeding in large quantities, at long intervals, of unadulterated whole milk, which taxes the stomach so heavily that the organ becomes disorganised and ceases to function normally. The conclusion of previous observers that calves which do not receive biestings at the start of life, are much more susceptible to this disorder of the food tube, as well as other diseases, than are biestings fed animals, is confirmed. The severe irritation of the stomach wall caused by injudicious feeding produces, by reflex action, such a rapid increase in the muscular movements (peristalsis) of the intestines as to cause diarrhœa. Prevention lies in the dilution of the milk with water as described (two or three parts of milk to one of water) the mixture being fed in the quantities prescribed. The distribution of the daily in-take of fluid into three feeds also helps. The cure of the disorder consists in dosing the calf with castor oil, limiting the food to boiled water only, for one day, and to 50—50 milk and water for some days thereafter till recovery is complete.

The Physiology of Tillering in the Paddy Plant.—By C. V. Sarvayya, B.Sc. (*The Madras Agricultural Journal, May 1932*).—The process of tillering is shown to be a result of light perceptive powers of the paddy plant. The primary stem under transplanted conditions, though for a time, acts as a host for subsidiary daughter tillers, remains for a long time as a parasite on the daughter and grand-daughter tillers. The existence of two different root-systems *viz.*, " Water roots " and " nutrition absorbing roots " is clearly brought out. Varieties which finish their tillering in the early stages are found to yield better than those which prolong their tillering phase.

Agricultural Statistics of British India, 1930—31

THE total area of British Provinces (excluding Indian States) is 669 million acres according to professional survey, or 667 million acres according to village papers. Of the latter area, 235 million acres represent uncultivable area comprising forests (88 million acres) and other area not available for cultivation (147 million acres); 154 million acres represent culturable waste other than fallow, and 49 million acres, the area left fallow during the year. The remainder, 229 million acres, was the net area actually sown with crops

during the year. If areas sown more than once during the year be taken as separate areas for each crop, the total area sown in the year 1930—31 comes to 262 million acres, which is slightly greater than that in 1929—30.

The total area irrigated amounted to 50 million acres, as against 51 million acres last year. Canals irrigated 26 million acres, wells 12 million acres, tanks 7 million acres, and other sources 5 million acres. Including the areas sown more than once, the gross area of irrigated crops comes to 54 million acres, of which rice occuped 19 million, wheat 10 million, barley, *juwar bajra,* and maize together 7 million, other cereals and pulses 6 millon and sugarcane 2 million acres. Cotton occupied 3 million and other non-food crops 5 million acres.

Food crops occupied 214 million acres of the total area sown (Including areas sown more than once) and non-food crops 48 million acres. Rice represented 31 per cent of the total area sown, millets 15 per cent, wheat 9 per cent, oilseeds 6 per cent, cotton and gram 5 per cent each, barley 3 per cent, maize 2 per cent, and jute 1 per cent. The noticeable increases were under rice (+ 1 million acres chiefly in Assam, Madras and Bengal,) and gram (+ 2 million acres mainly in the Punjab and the United Provinces). The only notable decrease was in the area under cotton (—2 million acres chiefly in Bombay, Madras and the Central Provinces and Berar)-—(*From a provisional statement issued by the Director-General of Statistics.*).

Crop Forecasts

WHEAT CROP IN THE C. P.

The following is the final forecast of the wheat crop of the Central Provinces and Berar for the season 1931—32 :—

Area.—The area in the Central Provinces and Berar is reported to be 3,468,547 acres which is greater than last year's actual area (3,097,872 acres) by 12 per cent and the quinquennial and decennial averages by 1 and 8 per cent, respectively.

Outturn.—According to the district estimates, the outturn for the province as a whole works out to 76 per cent of the normal against 80 per cent reported last year. Expressed in tons the yield for the Central Provinces and Berar together works out to 680,700 tons against 635,500 tons of last year, *i. e.,* an increase of 45,200 tons or 7 per cent.

Feudatory States.—Forecasts have been received from nine out of ten States which submit forecasts for this crop. The area sown in these States is estimated to be 115,035 acres and the outturns range from 64 to 120 per cent with an yield of 19,600 tons.

LINSEED CROP IN THE C. P.

The followfng is the final forecast of the linseedcrop of the Central Provinces and Berar for the season 1931-32 :—

Area.—The area in the Central Provinces and Berar together stands at 895,567 acres (drilled 610,900 acres and broadcast 284,667 acres) which exceeds the actual area (738,509 acres) of last year by 21 per cent but is less than the quinquennial and decennial averages by 6 and 5 per cent, respectively.

Outturn.—In the Chhattisgarh division, which accounts for nearly two-thirds of the total area sown, the outturns range from 106.5 to 112.5 per cent of the normal, while in the remaining districts they vary from 41 to 97.5 per cent. For the province as a whole, the outturn works out to be normal against 93 per cent last year.

Expressed in tons the yield for the province as a whole amounts to 83,700 tons as against 65,200 tons of last year, *i.e.*, an increase of 18,500 tons or 28 per cent.

Feudatory States.—Forecasts have been received from eight out of ten States which are required to send in forecasts for the linseed crop. The area in these States now stands at 94,216 acres and the estimated outturns range from 75 to 110 per cent with an yield of 7,835 tons.

The Co-operative Movement in the C. P., 1930—31

THE unprecedented economic depression of the year resulted in a partial set-back to the co-operative movement, and work was restricted to the policy of eliminating lifeless societies, re-organiziug those which are not beyond redemption and organizing fresh ones on cautious lines in suitable areas. 175 new societies were, however, registered, mostly in the Chattisgarh division, where the movement is in a comparatively healthy condition ; 175 societies were

re-organized and 204 societies cancelled. At the end of the year, the number of societies and their membership stood at 4,108 and 125,614 respectively, as against 4,137 and 128,800 respectively in the previous year.

The total cash recoveries of the loans outstanding against societies amounted to Rs. 12,51,233 in the Central Provinces and Rs. 8,57,373 in Berar as against Rs. 18,34,347 and Rs. 17,87,765 respectively in the previous year. These figures represent 16.9 per cent of the total demand of the year as compared with over 33 per cent in the preceding two years. The abnormal fall in the prices of agricultural produce was, no doubt, mainly responsible for the poor recoveries.

The loans outstanding against members of societies at the close of the year amounted to Rs. 70,01,851 in the Central Provinces and Rs. 1,05,11,287 in Berar as against Rs. 68,86,094 and Rs. 98,62,678, respectively, in the previous year. The percentage of overdues to the total dues increased from 53 to 62 in the Central Provinces and from 54.1 to 70.3 in Berar. Excluding dues from societies under award and liquidation, the overdues amount to 43.2 per cent in the Central Provinces and 47.4 per cent in Berar as against 35.2 per cent and 37.6 per cent, respectively, in the year before. As the Registrar has, however, explained in his previous report, on account of successive renewals and capitalization of interest, the bulk of the loans outstanding has become really overdue. Government would earnestly draw the attention of the authorities of the banks to the Registrar's analysis of the causes that have led up to this position and to the remedies indicated by him. What is really wanted is vigilant insistance on repayment and vigorous recovery of as much as possible every year from crops and by the sale of the immovable property of those whose debts are too heavy to be repaid from their annual net income in three to five years. Not only the instalments of the fresh advances of the year but also a substantial fraction of the old overdues must be recovered in this way every year. The investment of short-term deposits in long-term loans must also be abandoned once for all. The present serious position has resulted from the utter disregard of the central principle of co-operative finance as laid down by the Maclagan Committee, *viz.*, that "the creditors" real security consist not in the material assets of the members but in the ability and desire of the members to put the borrowed money to productive uses and to repay the loan out of the profits made thereby."

The number of societies under award stood at 244 in the Central Provinces and 95 in Berar. The liquidation proceedings of 205 societies were closed and 800 societies remained under liquidation at the end of the year. —(*Extracts from Government resolution on the working of the co-operative societies in C. P. and Berar during 1930—31.*)

The Working of the Agricultural Department, C. P. 1930—31

THE work of the department continued along established lines, no striking innovation being possible owing to lack of funds. The appointment of an officer as Deputy Director of Agriculture for Economics and Marketing resulted in greater attention being paid to economic problems and in particular provided for unified control of a largely extended marketing scheme for cotton. The net expenditure of the department, which has deen falling steadily since the year 1926—27, amounted to rather less than 7¾ lakhs of rupees.

A breach in the continuity of the work of the Agricultural College was caused by the civil disobedience movement during the year under review. However, it was found possible to continue the final or fourth year class from the middle of October and the results justified the step taken. The first quinquennial report on the department's experimental work and the review of past experimental work carried out on various farms since their inauguration prepared by the Principal of the Agricultural College while on special duty in addition to his tutorial work during the break will be of great assistance to the staff both in the field and the College.

Government also regrets to observe that political activities interfered with a newer type of agricultural institution, the Peace Memorial Agricultural School at Buldana. Experience both at Buldana and Yeotmal indicates that a real demand for vocational training in agriculture scarcely yet exists, although the present condition of agriculture is not such as to render a final decision on this subject desirable.

The Director's report deals with a step taken during the year to provide teachers trained in agriculture for employment in Vernacular and Anglo-Vernacular middle schools. This should ensure the imparting of more effective instruction in agriculture in schools of this type than by Agricultural Assistants unversed in methods of teaching.

A satisfactory feature of the year's work in the botanical section was the isolation and development of two new wilt resistant strains of cotton known as "early" and "late" *Verum*, so that including the original strain, there is now a choice of three *Verums* to meet the varying conditions of the cotton areas of the province. Selection work on rice has yielded important results,

such as the isolation of heavy yielding strains which are easily distinguishable from the wild rices, the elimination of which has always been a matter of perplexity for the rice grower.

The amount of improved seed of the main crops distributed during the year under review amounted to nearly 500,000 maunds as against nearly 600,000 maunds in the previous year. Although in the case of most other crops the figures showed an appreciable increase, there was considerable reduction in the case of seed wheat, growers preferring to use their own seed rather than incur expenditure on fresh stocks on account of the prevailing agricultural depression. To the same cause must be attributed the decline in the sale of implements and machinery.

The participation of Government in cotton marketing is a departure in policy justified by the fact that the new variety is essentially a spinner's cotton and it is necessary to market the lint in quantities which would attract the attention of the user as distinct from the buyer. These operations have extended rapidly in recent years and a conservative estimate indicated that reasonably pure seed sufficient to sow about 1½ lakhs of acres of *Verum* cotton would be available in 1930—31. The actual amount of cotton dealt with by the organization was about 11,000 bales or double the figure of the previous year, and it is calculated that the substitution of *Verum* for *Oomras* and its organized sale even to the modest extent described in the department's report benefited the growers to the extent of about 3 lakhs of rupees.

Government notes with particular interest that the work of cotton marketing has served as a focus for the activities of a number of agricultural associations in Berar and Nimar. That, however, in the opinion of Government scarcely goes far enough and Government concurs in the view of the Director of Agriculture that seed distribution and the marketing of crops is the work in which organizations of this kind and co-operative societies should take a prominent part in order gradually to relieve the agricultural department of activities which as they develop will pass beyond its sphere.—(*Extracts from Government resolution on the working of the Department of Agriculture, C. P.)*

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Editorial

DEBT CONCILIATION

THE Bill introduced in the last Session of the Central Provinces Legislative Council for the setting up of "Debt Conciliation Boards to relieve agriculturists from indebtedness" is a measure of very far-reaching importance. It has been truly said that "it is the bonds of debt that shackle agriculture." According to the estimates of the Provincial Banking Enquiry Committees, the agricultural indebtedness of India amounts to about 900 crores of rupees. The debt of our own Province has been estimated at over 36 crores. It represents Rs. 227 per cultivating family, and the interest charge on it amounts to Rs. 45-8-0 per cultivating family per annum, a sum equivalent to "2½ times the total land revenue demand and to more than a third of the normal balance from agricultural income." This terrible burden has been made all the more heavy by the recent catastrophic fall in the value of all assets owned by the cultivator, and in present circumstances he must find it difficult to meet even the interest charges. The co-operative movement in India is threatened with a disaster of the first magnitude owing to the accumulation of huge arrears which the societies are finding increasingly difficult to realize on account of the impecunious condition of their members.

The loss of confidence of the lenders and the loss of ability of the borrowers to meet their obligations in due time have thrown out of gear the whole credit mechanism. The time has come when a new adjustment between the borrower and the lender, in

the light of the changed conditions of the world, has become imperative if business were to revive at all. Attempts are being made all over the world to bring about this new adjustment. Recently the Government of the Union of South Africa summoned a conference of the representatives of Commerce, Industry, Agriculture, Banking and Finance to discuss the position of debtor and creditor in relation to the present economic blizzard. The conference was expected to go into the question of reducing by voluntary agreement the rate of interest on bonds, particularly those held on farm properties, in order to lighten the burden that is crushing the agricultural population.

The Central Provinces Debt Conciliation Bill is designed to give relief to the agriculturists by setting up Debt Conciliation Boards which would endeavour to compound agriculturists' debts by bringing about an amicable settlement between them and their creditors. As the Bill stands, the Board will have no power to force an agreement on either of the parties. Debtors and creditors may apply to the Board for settlement, and if the parties arrive at an amicable settlement regarding the amounts payable and the time and manner of payment, these will be reduced to writing and duly registered ; but if no agreement could be arrived at the Board will simply dismiss the petition. When a creditor is found unduly obstinate the Board will give a certificate to the debtor stating the amount of his debt and the offers made by him, and when a civil suit is brought for the recovery of this debt in respect of which a certificate has been granted the Court shall not allow the plaintiff any costs or any interest on the debt after the date of registration in excess of simple interest at six per cent per annum on the amount due on the date of such certificate.

The Bill is based upon the idea that agreement should be voluntary and the function of the Board is to assist the parties in arriving at this voluntary agreement. This is a very wise attitude to adopt ; for, however much we may condemn the

money-lender and his methods, we cannot forget that he is still the main almost the only source of finance for the agriculturist and anything calculated to deprive him of his legitimate dues or which will create a feeling of insecurity in his transactions with the cultivators, will result in virtually freezing the channel of rural finance. Such a state of affairs will be very embarrassing to the cultivators themselves who, in the absence of any adequate alternative source of finance, are entirely dependent upon the *Mahajan* for carrying on their operations. Further no one can deny that a large part of the debt of the agriculturists is due to their own improvidence. To help them to get clear of their commitments by legislative or executive pressure would be to encourage improvidence and to penalize thrift and would ultimately demoralize the borrower and make him still more irresponsible. There is no intention to belittle the importance of debt conciliation but it is necessary to emphasize the importance of giving due consideration to all aspects of the question and to the necessity for restricting the proceedings to real conciliation between the two parties and not virtual cancellation of the debts at the expense of the lender. The cultivator must pay all the legitimate claims of the creditor who has helped him with cash in the time of his need. This is especially the case with the co-operative societies against whom no charges of usury or unfair dealings can be levelled, whose loans have always been for production purposes and whose capital constitutes the hard-earned savings of thousands of poor people just beginning to understand the value of thrift and co-operation. Cancellation of a good part of their outstandings would result in the collapse of the co-operative movement, with the success of which the chances of any regeneration of the peasantry of India are so intimately bound up. Anything that would cause a setback to the movement would be positively harmful to the ultimate welfare of the cultivators for whose relief and benefit the conciliation proceedings are primarily intended.

The Conciliation Boards can, nevertheless, achieve a great deal in giving relief to the cultivators. The Boards can go into the history of each case and can help to give relief to the cultivators by reducing interest rates and interest accumulation where there is evidence of unconscionable rates being imposed, by cancelling ancestral debts not incurred for production purposes, and by fixing suitable instalments for repayment in the future, with due regard to the ability of the debtors and the present slump in prices. These alone would give very great relief to the poor cultivators much of whose burden is made up of ancestral debts and accumulated interest.

The success of all debt conciliation operations will depend on the ability of the debtor to pay down cash as soon as an amicable settlement has been arived at between the debtor and his creditor. As the C. P. Banking Enquiry Committee pointed out many creditors will be willing to accept a much smaller amount in settlement of debts provided the debtor will pay down cash. This points to the necessity for creating agencies which can give long-term loans at low rates of interest, on the security of the cultivators' immovable assets, by which they can clear their present debts. Past experience in debt conciliation in this Province shows that, in the absence of such agencies, mere reduction in the volume of debt conditioned by instalment payments in the future will not lead very far; on the other hand, it is likely to result in much bitterness and suffering by making the creditors relentless in collecting the instalments.

Original Articles

COTTON POOLING IN THE CENTRAL PROVINCES AND BERAR

BY J. S. GURJAR, L. AG.

As a result of research work on cotton carried out by the Botanical Section of the Agricultural Department, large areas in the Central Provinces and Berar are now being put down to *verum* cotton. This cotton

is a type of Neglectum which was formerly being grown in mixture with other types. The work which led to its isolation and subsequent production as a pure crop was initiated owing to the necessity for finding a substitute for the once-popular type *roseum* which in recent years has fallen into disfavour owing to its susceptibility to Wilt. The immediate object of the Botanical Section was to find a variety which could be grown on Wilt-infected areas. Three pure line strains of *Verum* were ultimately built up which were highly resistant to Wilt. In 1927 7500 lbs. of seed of these strains was given out to cultivators, mainly of strain 262. The results everywhere were reported to be satisfactory not only in respect of resistance to Wilt but also of yield and quality of lint. The lint was sold at very high prices with the result that the variety suddenly sprang into popularity alike for Wilt-infected and disease-free areas. The rate of spread is shown by the following figures.

Year	*Seed distributed in Khandis*	*Area grown under Verum*
1927—28	9½	375
1928—29	51	5,000
1929—30	587	40,000
1930—31	3,750	157,000
1931—32	6,549	261,600

Spinning tests carried out at the Technological Laboratory, Bombay, showed that the samples were suitable for spinning a warp yarn of 18's to 20's and up to 26's against the ordinary Berars 8's to 12's.

The Government undertook the marketing of this *Verum* cotton for two reasons.

(*a*) To secure an adequate price—The cotton was collected, graded, ginned and offered under conditions which would secure an adequate price for its quality by establishing direct contact with consumers. In the absence of such an arrangement in its early days, the cotton would have come to market in small quantities and would not have secured any premium at all. On the contrary it might have fetched a smaller price because of its lower ginning percentage and this cotton would have disappeared from everywhere except on Wilt-affected lands.

(*b*) Another important object was to maintain an adequate supply of pure seed. The *kapas* of known standard and purity was brought to the ginning centres, where all the available seed was concentrated,

and its distribution was a relatively simple matter. Growers retained as much seed as was required for their sowing and the balance was sold by the Agricultural Associations and the staff of the Agricultural Department in suitable places. By this system a maximum quantity of seed was distributed and a certain measure of control was maintained on seed distribution and the subsequent crop.

When the department undertook marketing work they had to face two important problems; (*a*) adequate control over the whole business, and (*b*) financing the grower till such times as his stocks are sold and proceeds were recovered.

With regard to (*a*) the work was managed in the first two years of its spread by the permanent district staff. In 1930 the Indian Central Cotton Committee provided funds to employ additional staff to assist in the work. In 1931—32 the Indian Central Cotton Committee sanctioned a comprehensive scheme costing Rs. 50,000 to meet the increased business of the season due to increased area under *verum*.

(*b*) As regards the collection of cotton from the several cultivators at the ginning centre, the preparation of the same for market and the collection of the sale proceeds when the sale is effected—all these operations take time. But money had to be found to finance the growers till sale proceeds were realised and distributed and also to meet the expenses of preparing cotton for the market. In 1927—28 the business was managed without advances. Since 1928 Government helped by allotting funds as follows :—

Year.	*Rs.*
1928—29	50,000
1929—30	200,000
1930—31	450,000
1931—32	200,000

In the first two years advances were given free of interest. In the last two years interest at 4 per cent was charged on sums paid as advances but no interest was charged on money paid for expenses. In the first two years the money sanctioned was used only once, but in the last two years the money was kept in the personal deposit account of the Director of Agriculture and could be turned over as many times as was necessary, before its final recoupment to the treasury. The condition in all these years was that the money should be paid back to Government before the end of the financial year.

During the first two years the marketing of lint was in the hands of the staff of the Botanical Section. In the third year the work was taken over by the Director of Agriculture. The magnitude of the operations increased still further in the following year and it was found necessary to entrust the work to a whole-time officer. This was possible by the appointment of the Deputy Director of Agriculture, Economics and Marketing. He was in charge of the Central Sales organization with headquarters at Nagpur, and controlled sales in the whole cotton area, while the arrangements in the districts, though settled in consultation with him, were controlled by the Deputy Directors of the Circles.

The general plan of marketing work in 1930—31 may be described as follows: Cotton collected at the ginning centres was graded according to its purity, class and cleanliness. Provision was made for the pure seed supply of 1931. The *verum* area was split into separate territories for the purposes of pooling and sale. The operation was further split up within the territory by having four pools of limited duration and a central sales organization was set up through which all sales were to be transacted. In other words the selling unit in that year consisted of all centres within a district. Each cotton centre dealt with its cotton in four separate pools, and a pool embraced all the cotton received within a specified period. For example the first pool contained all the cotton received from the 1st to the 20th November, and the second all the cotton received between the 20th November and the 10th December, and so on. The result of this arrangement was that the distribution of proceeds in any one pool in a territory could not be made until all the cotton, contributed to that pool by various centres constituting the selling unit had been sold. The selling of a pool *in toto* became difficult as, out of four grades in a pool, some were more readily sold than the others with the result that the desired types of later pools were sold while the undesired types of the earlier pools remained in stock. The quality was also found to vary very considerably within the same territory and even within one and the same type. This involved disputes over the quality and some centres in the territory gained at the cost of others. Full discretion in the matter of sale was vested in the Central organization. The Agricultural Associations and some of the principal growers thought that the offers ought not to have been dealt with without consulting them. For all these reasons the marketing scheme for 1930—31 did not meet with universal approval and a fresh scheme for 1931—32 was drawn up in the light of the experience gained and was

therefore agreed upon by representatives of Taluq Agricultural Associations. It differed from the previous one on the following points :—

(1) Each pressing centre was constituted as an independent selling unit and as soon as a unit had collected a marketable lot, the cotton was sold and the proceeds were distributed to those growers who had contributed to that lot. The result of the above change was that there was no delay in disbursing the proceeds, and sale lots were uniform, being made up from one small centre only, instead of from several centres.

(2) A local Committee was formed at each pooling centre to advise and assist the officer in charge of the centre. No sale was made without previously obtaining the Committee's approval of the rates offered.

(3) A Central Committee, consisting of one representative from Nimar, two from Berar, one from the Nagpur-Wardha tract and the marketing officer, was appointed to deal with general matters connected with sales.

In 1927—28, 88 bales were collected, 50 of which were sold at Rs. 440 per khandi at Akola when Bombay price for Broach was Rs. 361 and for Oomras Rs. 330. A further lot of 38 bales fetched a premium of Rs. 88 over the local cotton. In 1928—29, 822 bales were collected and they secured up to Rs. 430 per khandi with Broach standing at Rs. 360. In 1929—30, 5,500 bales were sold through the department and an average premium secured over Oomras throughout the season was Rs. 101. In 1930—31, 11,162 bales to the value of Rs. 11,58,891 were sold by the department. During the first two years all the bales produced were sold to local mills; in the third year a few bales found a market in Bombay; but in 1930—31, about 6,000 bales were sold at Bombay and other places outside the Province. The average rate at which these 11,162 bales were sold, was Rs. 212-7-0 per khandi (f.o.r. Bombay basis) when the average quotation for Broach and Oomras between the 1st November and the 27th February (calculated at daily average telegram rates) was Rs. 189-12-0 and Rs. 156 per khandi respectively, or at a premium of Rs. 56-7-0 over Oomras and Rs. 22-11-0 over Broach. This premium worked out at 36 per cent over Oomras and 12 per cent over Broach. In 1931—32, the department sold 2,255 bales to the value of Rs. 2,81,278. The average rate at which these bales were sold (f.o.r. Bombay basis) was Rs. 269-2-0 per khandi, when average daily quotation for Broach and Oomras, between the 25th November and the 21st March as per price telegrams was Rs. 209-6-0 and Rs. 205-9-0 per khandi

respectively. This worked out to a premium of Rs. 59-12-0 over Broach and Rs. 64 over Oomras or 28.54 per cent over Broach and 31 per cent over Oomras.

During 1930—31 it was estimated that an equal quantity of cotton, as was handled by the pool, was sold privately by traders. In 1931—32, owing to the high parity ruling in Oomras, due to a short crop as a result of unfavourable season, practically the whole of the *verum* crop was absorbed by local mills; and an attempt was made to trace the small quantity exported by traders outside the Province. From information received it has been ascertained that *verum* equivalent to about 21,000 bales was purchased by the local mills. Though *verum* rates have varied a good deal, the percentage of the premium was maintained. It may be pointed out that the pool served the object of securing a substantial premium for this cotton. This also affected the *verum* sold in open markets. Since 1929—30 *verum* began to appear in the open market. But it fetched premium only during the continuance of pool. There is evidence to show that *verum* did not secure any premium till the pool began to operate and by the time the pool operations were closed, the premium in most of the important markets virtually disappeared. It is, therefore, in the interests of growers to maintain this organization.

Verum did fairly well during the first three seasons and under the stimulus of high prices the area under it increased enormously. The present strain of *verum* No. 262 has not behaved altogether satisfactorily under the unfavourable climatic conditions of the last two years, and particularly of the past season, and some setback may be expected in respect of the area under *verum* in the current season. Many growers will still continue to grow it in the expectation of a favourable season. But its chances of success are doubtful. *Verum* has proved its worth to the cotton spinner and there is no doubt that there will be a definite demand for this cotton from cotton mills. The department will, presumably continue with the present strain for some time until it can be replaced by a strain which will stand adverse climatic conditions better.

From the account given above the importance of these operations, as well as the profits derived by the growers from these operations, will be apparent. A certain portion, and probably a substantial portion, of the cultivators' proceeds is always lost in paying the charges and profits of middlemen, through whom he disposes of his produce. The

operation described in this paper is an attempt to establish direct contact with the consumer to eliminate middlemen and to bring down the expenses of marketing to the minimum. What has been done in respect of *verum* could be done in respect of other cottons or other produce of the cultivators. This will be a very useful line of work for the agricultural associations and other organizations working in the interests of the cultivators.

THE OIL-SEED CRUSHING INDUSTRY IN INDIA

Its Importance in Agricultural Prosperity

BY P. D. NAIR, M.A., L. AG.

The oil-seed crushing industry in India, like most other industries, has been before the public and the Government for a very long time. During the early years of this century when the Government of India and some of the provincial Governments launched on a policy of hastening the industrial development of the country, the United Provinces Government started an experimental oil-mill to investigate the possibilities of extracting oil from cotton-seed on a commercial scale, but the venture was closed down in a couple of years. In 1918 the Industrial Commission recommended that "this important matter should be examined by the experts" and at the same time they made proposals "to provide scientific and economic assistance." The oil-milling industry was included by them amongst the industries that might be aided by the provincial Departments of Industries. Nothing, however, was done in subsequent years to give effect to their recommendations. Ten years later the Royal Commission on Agriculture was forced to observe that "an extension of the oil-crushing industry would undoubtedly tend to promote the welfare of Indian agriculture and we would recommend the investigation of its possibilities to the earnest consideration of all local Governments." At about the same time the Punjab Government sent round one of their experts to study the problem all over India. Last year the Advisory Board of the Imperial Council of Agricultural Research set up a committee to consider the question afresh in all its bearings. Thus the subject has received the attention of two Royal Commissions and several other committees but nothing has been done so far to give any real stimulus to the industry.

India as a producer of oils.—India, China and the United States of

America are at present the three important oil-seed producing countries of the world, and India is the largest producer of all. In 1927 the Indian production of oil-seeds was estimated at 6,630,000 tons. During the same year China produced 5,279,000 tons and the United States of America 5,139,575 tons. India grows a variety of oil-seeds such as linseed, groundnut, castor, rape, mustard, cotton-seed, cocoanut, etc., while most other countries grow only one or two varieties to any considerable extent. India holds almost the monopoly in the production of castor, rape-seed and niger, and she is the largest producer of groundnuts, contributing to nearly two-thirds of the world production. She stands next to the United States in the production of cotton-seed.

On an average, about 8 per cent of the cropped area of British India goes under oil-seeds every year. Madras has the largest area, amounting to nearly 16 per cent of the area sown. Burma, Bihar and Orissa and the Central Provinces also grow vast quantities of oil-seeds. It is grown by the cultivators as an important "money crop" and the produce is sold in the markets for cash.

Export trade in oil-seeds.—A very large proportion of the annual crop is consumed within the country itself, but considerable quantities are exported to foreign countries. On an average, about 18 per cent of the total production is exported. The magnitude of our trade in this commodity can be realized from the fact that oil-seeds occupy the fourth place among India's export trade. During 1929—30 India exported 1,195,000 tons of oil-seeds valued at 2,646 lakhs of rupees. India is the largest exporter of oil-seeds. The United States of America consume practically the whole of their own production. China sends out mostly soy-beans which form 85 per cent of her oil-seed export. India, on the other hand, exports large quantities of a variety of oil-seeds. Practically the whole of the world's supply of castor, *mowra*-seed and niger go from India. She supplies about three-fourths of the world's export trade in poppy seed and one-half in groundnuts. She also supplies about one-quarter of the world's demand for cotton-seed and sesamum. The northern countries of Europe are her principal customers. The United Kingdom, Germany, France and Holland are the heaviest buyers. The United States of America and Japan buy large quantities of castor, and Italy buys our rape-seed and linseed. The United Kingdom buys large quantities of cotton-seed. We have thus a very extensive trade in oil seeds, and the prosperity of a very large section of our cultivators is involved in the disposal of this commodity.

A declining trade.—It is to be feared that India is slowly losing the pride of place which she has so far held in the world's trade in oil-seeds. During recent years her exports have always been much below the pre-war level. The area under linseed, rape, mustard and castor shows a decrease since the War. The area under sesamum is fairly steady, groundnut alone shows an increase. There is growing competition from some of the other countries of the world. The world's linseed supply is now controlled by Argentine. During the early years of this century India practically held the monopoly in this commodity and her annual exports were more than half-a-million tons. During recent years the United States of America, Canada and Russia have started growing linseed and India's share of the world's supply has been steadily falling, and it is now in the neighbourhood of about 10 per cent. The world's supply of sesamum is now controlled by China. The area under groundnut is rapidly increasing in Africa, particularly in Senegal and Uganda, and it is very likely that the yields from the virgin lands of Africa will soon outstrip the Indian production. The discovery of methods of deoderization and decolourization has reduced the demand for cocoanut oil, it being cheaper to use other inferior oils. As in other agricultural produce, there is considerable over-production of oil-seeds and the supply is more than the world can consume at present. This is one of the principal reasons for the abnormal fall in prices of oil-seeds. If we look around and study the tendencies of world trade, the indications are that the demand for Indian oil-seeds from foreign countries will tend to fall in the future. This will result in a further fall in the price of oil-seeds in India and great embarrassment to the growers of this commodity.

The time has come when we must take stock of the situation and arrive at some definite policy for the future. Either we must restrict the area under oil-seeds and pay for the imports of *ghi* and other oil products, or we must establish our own oil-milling industry and manufacture the products which we are now importing. The first alternative is out of the question. The uncontrolled exports of oilseeds have already done great harm to the country.

Oil-milling and Agriculture.—The oil-milling industry, more than any other, is very intimately connected with agriculture—the greatest industry of India. Oil forms an important constitutent in the diet of the people. It is very largely used for culinary purposes in all Indian households and, besides, women and men use oil almost daily for

anointing the hair and the body. The cake that is left behind after the oil has been extracted is a very nutritious feed for the cattle—the chief source of power in Indian agriculture. Oil-cake is the most nutritious and the cheapest concentrated food available for the work and milch stock of India. The total quantity of cake required, to feed properly the 150 million cattle of British India will be much more than would be available in the country even if the export of oil-seeds and cakes were to be completely stopped today. Besides, oil-cake is one of the most effective and cheapest form of soil fertilizer—an essential requisite for crop production. In these circumstances it is quite plain that India cannot afford to export oil seeds without prejudicially affecting the interests of her population, her cattle and her soil.

The evils of exporting oil-seeds.—There was perhaps a time when statesmen and economists used to look upon the enormity of India's exports and her apparent favourable balance of trade with complacency. It is now quite clear that the export of vast quantities of the potential raw material of industry is a sign of weakness rather than of strength. It is an unmistakable sign of her industrial inefficiency. Other countries import raw materials and export finished products. On the other hand, two-thirds of the exports of India consist of raw materials and nearly 80 per cent of the imports consists of manufactured articles. The result is, loss of work and loss of profits. The export trade in oil-seeds is a typical case in point. Much of the oil-seed that we export is re-imported into the country in the form of finished oil products such as vegetable *ghi*, soap, paints, varnishes, etc. If, instead of exporting the oil seeds and re-importing the finished products, we could work them up in this country it would provide employment for many unemployed people in this country. The profits would remain in the country and in addition the freight would be saved. There is more than this in the case of the particular raw material under consideration. The export of oil-seeds results in the loss of the valuable cake to the country. To maintain the fertility of the soil it is necessary that this source of valuable nitrogen should be returned to the soil either through feeding the cattle or straight as manure. When we export a million and a quarter tons of oil seeds every year we are really exporting so much of fertility without any corresponding return to the soil. This long-continued looting of the soil is partially responsible for the extremely low yield of Indian soils. By exporting oil-seeds not only is the soil deprived of its organic matter and nitrogen but we are also depriving the cattle of their legitimate food. Feeding the cake to

the cattle results in a two-fold blessing. The cattle get a nutritive feed and the resulting dung has a much greater manurial value. Nobody can deny the fact that Indian cattle are underfed. The puny emaciated hide-bound creatures with their low milk-yield and irregular fecundity offer sufficient evidence of under-feeding. And yet we export the cake to foreign countries! The improvement of Indian agriculture is to a large extent interwoven with the proper feeding of India's cattle. The use of heavier implements and the adoption of more intensive cultivation are dependent upon a more powerful type of draft animal which can never be secured unless the animals are fed on more nutritious food; and in India we cannot find anything cheaper and more suitable than oil-cake.

Oil milling in India.—A very large percentage of the oil-seeds grown are crushed within the country mostly in the bullock driven *ghanies* or *chakkus,* and to a certain extent in modern power-driven mills. The indigenous *ghani* can be seen in most villages even today. Bombay Presidency alone has about 7,000 of them. The total output of these old-fashioned *ghanis* may be considerable but they are extremely slow and very inefficient. A very large percentage of oil is left behind in the cake unextracted. In fact the indigenous method of extraction leaves so much oil in the cake that it will be profitable even to subject the cake to further extraction by the solvent process. But Indian stock owners generally prefer country *ghani* cake to the mill cake on account of the notion that the former has a greater feeding value by virtue of its high oil content. For the same reason they prefer feeding cotton-seed to cotton cake. This is a very wasteful method which can be removed by proper propaganda work.

There are also a number of power-driven mills. In 1927 there were 75 of these power-driven mills in Bombay Presidency and 13 in Madras. There are a number in Calcutta engaged in crushing mustard and cocoanut. There is a tendency everywhere to replace the old wooden *ghanis* by small factories with rotary iron *ghanis* worked by oil-engines.

There are also a few big mills like the New Oil Mills at Wadala, Bombay, and the Tata Mills. Whether big or small, the oil-seed crushing business in India appears to live a rather precarious existence. This is particularly the case with the bigger mills. For example, the Wadala Oil Mills, though equipped with the most up-to-date labour-

saving plant, worked by electric power, had to go into voluntary liquidation in 1927. The Tata Oil Mills have not declared any devidend since 1924. The smaller mills fare slightly better.

The Difficulties.—There are several difficulties in the way of the prosperous working of these mills. In the first place there is considerable difficulty in disposing of all the oil produced. The demand for oil, as such, in India is limited and it is largely met by the country *ghanis*, particularly in villages. In the past, the cheaper kind of vegetable oils were used for lighting and the amount of oil utilized in this way must have been considerable. The introduction of kerosene oil has resulted in the complete disappearance of the demand for vegetable oil for this purpose. There is very little export of oil from India on account of the fact that the foreign countries have imposed heavy duties on oil while they admit the oil-seed free, so these countries are prepared to buy only oil-seeds and not oil. The problem of transporting oil to distant places is also a serious one. There is no industry to supply the right type of containers. The kerosene-oil tins are too small and the wooden barrels leak. In the case of cocoanut oil the problem is a very serious one due to the fact that the oil freezes at a temperature below 60° and it goes difficult to take the oil out. Another serious difficulty is about the disposal of the cake. There is as yet no general demand for cake in India, either for feeding or for manure. There is a vicious circle here. There is no demand for cake because agriculture is bad, and agriculture is bad because cake is not utilized! But it must be admitted that the problem of manuring in India is bound up with the problem of irrigation. Where irrigation facilities are not available the use of costly manures is not likely to lead to any profit. On the other hand, in places where irrigation facilities are available manuring is generally done and cake is used. For example, oil cakes are extensively used as manure in the cultivation of sugarcane all over India. Any large scale demand for cake for manure is not likely to exist till irrigation facilities improve and intensive cultivation is adopted. The same is the case with the use of cake for feeding cattle. Till agriculture becomes more profitable the cultivator cannot afford to feed his cattle with cake. The development of the oil industry is thus inextricably connected with the development of Indian agriculture.

The smaller mills that make profits are those that work up some of their by-products. The success of the oil-milling industry, whether on a big or a small scale, depends upon the ability of these mills to take

up side-industries like soap making, preparation of *ghi*, etc. India can no longer look forward to a profitable export trade whether in oil-seeds or in oil. She must work up these raw materials and seek her own market for the finished products. The 350 million people of this land comprising one-fifth of the population of the world will afford a sufficiently extensive market for the industries of the country. Vast quantities of oil products are being annually imported into India in the form of soaps, vegetable *ghi*, axle grease, lubricating oils, paints, varnishes, etc. If the country can only manufacture all these articles to meet her own demand the problem of the oil-crushing industry will easily be solved. Not only will all the oil produced in this country then find a ready sale but it will even give us an opportunity to increase the production of oil-seeds.

The use of soap and the making of it is known in this country since time immemorial; yet we have not attained any high proficiency in its manufacture. Much of the high-quality soaps consumed in this country are imported at an annual cost of about two crores of rupees. The technical skill required for their manufacture is lacking. The Government soap factories at Calicut and Mysore have shown what can be achieved in this direction where proper skill and initiative exist.

The question of vegetable *ghi* is fraught with considerable controversy. The so-called vegetable *ghi* is only ordinary edible oils subjected to certain processes by which they are decolourized and frozen to assume the appearance of *ghi*. In the absence of effective laws to prevent the adulteration of food, the import of vegetable *ghi* is supplying very good material for adulterating *ghi* and it is becoming more and more difficult to procure pure *ghi* in towns and cities. Some people would entirely cut out the import of this stuff in the interests of public health. The evil of adulteration can be prevented by the promulgation of effective food-laws, but vegetable *ghi* is now supplying the demand for a cheap form of *ghi* for ordinary purposes, from confectioners and the poorer classes, and there is bound to be a great demand for this article in India. Some Europen countries, particularly the Netherlands and France, are making huge profits by the manufacture of this article which finds a ready market in most Eastern countries. Annually about 2 crores worth vegetable *ghi* is being imported into India. There appears to be great scope for this industry in India, if it can be started in this country. By converting into *ghi* many kinds of oil which people ordinarily do not consume on account of their disagree-

able taste or smell become very attractive for culinary purposes. But the process of manufacturing the *ghi* on a commercial scale is yet a secret known only to Europe. Our technological laboratories must be able to solve this mystery.

The manufacture of axle-grease, lubricating oils, etc., are beset with similar difficulties. Although the raw materials are available in plenty the process of manufacturing them on a commercial scale is unknown. It is here that the technological institutes can render real assistance to the country. Even if the processes of manufacturing some of these articles are discovered, the new industries will find it difficult to push through the ring of foreign competition. Government will have to come to their rescue by giving adequate protection for some time.

The problem of developing the oil industry of India, though vitally connected with several other industries, is a very complicated one and one beset with several difficulties. Nevertheless the difficulties have to be met and overcome. Otherwise the prospects are gloomy for a very large section of farmers now growing oil seeds. The intimate relation which this industry bears to agricultural prosperity brings it well within the sphere of bodies like the Imperial Council of Agricultural Research and, to come even nearer home, the Laxminarayan Bequest Scheme Committee. Help could be given in several ways. Indian oil-seeds are capable of considerable improvement in their oil-producing capacity and other desirable characters. This involves the combined effort of the chemist and the botanist. The appointment of oil-seed experts in all important provinces to study some of these problems would be very helpful. Finance might also be provided for schemes of research on the utilization of oil and the manufacture of some of the important oil products.

RICE RESEARCH IN THE CENTRAL PROVINCES

BY R. B. EKBOTE, L. AG. (HONS)

Since the time methods of plant-breeding have become the working tools of the crop botanist in his craft, the improvement of crops through these methods has been one of the chief activities of all departments of Agriculture. Investigations for high-yielding and promising types have resulted in the production of many choice strains in crops. Rice, though occupying the largest area and constituting the staple food of most people, has received its due share of attention only

lately, and a well organized research on a large scale as in cotton has just been made possible through the grants of the Imperial Council of Agricultural Research and the Empire Marketing Board. Till now attempts have been made to evolve good strains in rice in some provinces, but these have been isolated and incomplete. It must be mentioned here that research in rice presents certain peculiar difficulties and a complete classification of varieties is possible only through the organization and collaboration of research work in all the rice-growing provinces.

Rice is not a very remunerative crop but all the same plays a significant part in the agricultural economy of the country. It is grown over 80 million acres and its cultivation on a large scale extends to more than one province. This is evident from the following figures:—

Provinces.	*Area under rice.*
Bengal	22 million acres.
Bihar and Orissa	15 do.
Burma	11 do.
Madras	11 do.
United Provinces	7 do.
Central Provinces	5 do.
Assam	4.5 do.

But the outturn of our rices is miserably low when compared with that of other rice-growing countries. This is clearly seen from the following table:—

Countries.	*Yield per acre in lbs.*
Argentine	2,027
Bulgaria	1,609
Egypt	2,668
Formosa	1,663
Indo-China	1,005
Italy	3,506
Japan	3,014
Java and Madura	1,318
Korea	1,509
Siam	1,936
Spain	5,146
United States of America ...	1,742
India	878

India has the largest area under rice among the countries mentioned above but comes last as regards outturn per acre. It will therefore be realized how very important it is to improve the yielding capacity of our rice varieties.

What has been said of India in general is true of our own Province. Rice occupies by far the largest area, *viz.*, 5,193,000 acres (while cotton another important crop is grown on 5,057,000 acres). The outturn of rice in the Central Provinces is only 647 lbs. per acre. This in itself shows the great scope for improvement in this crop. There are other facts in addition to the above which call for early and concerted action. Rice constitutes the staple food of a large section of inhabitants, in the western, southern and eastern parts of the Province. Attempts made hitherto towards breeding improved strains have only touched the fringe of the problem and a thorough and complete analysis of this crop has yet to be done. The area on which improved strains have gone so far is negligible, *viz.*, 2 per cent, which indicates the absence of high-yielding and desirable types. These considerations are sufficient to justify the launching of a rice research scheme in this Province. A few words by way of suggestions regarding the lines of work may be of interest.

Before taking up the problem of improvement of the rice crop, it is essential to know, in the first place, the objects of improvements. So far as our Province is concerned there are two classes of people who consume rice, *viz.*, (1) the cultivators, labourers, etc., and (2) the rich and middle classes. The former class requires cheap and coarse rice while the latter prefers fine and fragrant grains. The aims in breeding therefore are two-fold, *viz.*, (1) to increase the yield of coarse varieties, and (2) to breed high-yielding fine and scented types. Besides, early maturing types that will grow without irrigation are needed in parts where irrigation facilities are lacking. Again, to avoid the chances of admixture of wild rices, types that will easily be distinguished from the above are required in places where wild rices infest the borders of rice fields. It must be mentioned here that such a strain has been evolved lately but that does not completely solve the problem. We want similar but higher yielding types, if possible. In addition, strains resistant to diseases and having good stooling habit are also desired. The above-mentioned facts have always to be borne in mind while conducting the work and should never be lost sight of.

As regards the lines of improvement they are the same as in any other crop, *viz.*, (1) improvement of local varieties by isolation, (2) introduction of desirable and promising types from outside the Province, and (3) building up strains having the desirable characters through hybridization. A few words regarding each may not be out of place.

(1) The improvement of local varieties.—This necessitates the work of "Pure-line-selection." For this a collection of many samples from all over the Province has to be made. From the cultures of those samples pure-lines have to be raised. Then follows the work of classification of these pure-lines. It must be mentioned here that a classification has been done recently in our Province but we have only isolated a few types. The pure lines that will be raised will be very many and they may be of different types. Secondly, rice presents certain difficulties in classification in that it has limited adaptability to different conditions of climate and soil. As pointed out by Dr. Graham, a variety that flowers in a particular line in the northern districts does not take the same period in eastern parts. There is also a good deal of variation in the period of maturity from locality to locality. There is a sort of controversy among the rice-breeders as to whether these agricultural characters can be taken into account in classifying the rice types. Much can be said on both sides, and a detailed account would be out of place here. Suffice it to say at present that a scheme that neglects some of the important agricultural characters such as period of maturity, etc., is bound to be imperfect. An attempt must be made, therefore, to study all the characters and if possible in different localities.

After the classification has been done yield trials of the best and selected types should be undertaken. Variations in the soil and climatic conditions in rice-growing tracts, differences in methods of cultivation, and the limited adaptability of rice varieties will necessitate the selection of a large number of strains. This will require the conduct of yield trials at more than one place. This is however a necessary step before anything could be said about selected types.

(2) Introduction of promising types.—With a view to test the yielding power in our conditions of soil and climate and make use of one or more desirable characters possessed by them, promising and reputed types will have to be introduced in our Province.

(3) Improvement through hybridization.—This method should be resorted to after the attempts to effect improvement through selection

and introduction have been exhausted. Rice is well known for its multiplicity of forms and much of the improvement could be done through pure-line-selection. It may be that all the desired characters will not be found in a single type. The combination of characters present in different forms will therefore have to be done through hybridization. But it must be remembered that unless and until investigations of improved types through selection are complete attempts at hybridization will be premature.

LAND DRAINAGE

(With special reference to tile drainage as practised in the Nagpur Agricultural College Farm)

BY K. S. S. IYER, B. E.

Introduction.—Of the several factors affecting crop production, an adequate and timely supply of water must be considered as even more important than the fertility of the soil. This consists in (*a*) supplying water to crops when required by irrigation, and (*b*) removing excess water by drainage. In this article an attempt is made to show how the latter helps to improve crop production.

Drainage is required for extending and intensifying cultivation. Extensive drainage projects—some paid for by the State and some by private co-operative enterprise—have been accomplished in Europe and America and as a result very extensive areas of water-logged lands have been reclaimed. All the works have been found to repay their cost in a few years and thereafter the tracts become rich provinces maintaining a large population. Reclamation of wet lands by drainage is becoming a very common feature in Europe and America. A few instances of huge schemes of drainage in Europe may be cited here to show the benefits derived therefrom. The 'English Fens' covering about 7 lakhs acres of tidal overflowed lands were reclaimed by levees, ditches and pumping plants. This work covered a period of two centuries and now consists of several towns with railway facilities, etc., and the gross product of this area is worth over 30 million dollars per year. Another example is of the 'Haarlem Lake' in Holland covering an area of over 43,000 acres reclaimed at a cost of nearly 5½ million dollars. This area is inhabited by over 16,000 people and produces

much of the food raised in northern Holland. The 'Zuyder Zee' project in Holland, one of the biggest in the world embracing about 827 sq. miles and costing over 125 million dollars and expected to take about 35 years for completion, has been undertaken by the Dutch Government about the early part of this century. It was estimated in 1908 that about 229 million acres of land in the United States of America needed drainage. 'In all such schemes in Europe and America the State has invariably financed the schemes and sometimes encouraged private and co-operative enterprise.

Need for drainage in India.—With her ever-increasing pressure of population, India must very soon manage to find fresh lands for cultivation and also try to get the maximum outturn with the minimum area of land.

In many parts of India and over large areas in the Central Provinces, plant growth is checked not by want of water but by excess of it due to heavy rainfall concentrated over short periods. During the early showers of the monsoon, which are generally heavy, the pores in many soils get choked with water. The passage of water downwards being generally slow, there is stagnation of water on the surface of the field. Fresh air is prevented from reaching the plant roots. The outlet for carbon dioxide formed in the soil gets choked. The root system gets practically suffocated and the crop in general has a slow and stunted growth with yellow foliage. Plants in water-logged areas develop shallow surface-roots and such plants are apt to die off later on owing to their inability to keep touch with the receding water level. Most of the cotton tracts of the Central Provinces consist of a heavy black clayey soil, and the absence of adequate drainage is an important factor which often affects the outturn of cotton in these tracts. Further, where the land is water-logged, application of manure produces no effect, the soil cannot be worked to a good tilth, weeds grow faster than the crop and the outturn of crops will be poor.

Drainage of wet and water-logged areas is therefore a matter of great importance. Wet spots hinder farm operations and transportation in occupied farm areas. The poverty of the average Indian cultivator, his apathy towards any improvements, the absence of suitable outlets for the drains, and the low price level of agricultural produce are some of the important factors which hinder improvement of land in this direction. To be an economic proposition at all it could only be done in fields which can grow crops having a high money value.

Where drainage is indicated.—Intermittent nature of the rainfall, soil variations and general features of the country necessitate artificial control of excess water. All soils require drainage to remove excess water and in most soils natural drainage facilities exist. But in places like the following artificial drainage has to be resorted to, to prevent water-logging :—

(1) Flat lands such as the deltaic tracts which often remain wet due to overflow of streams ;

(2) Bogs or marshes holding free water near the surface for a long time ;

(3) Large flat areas or depressions having heavy clay or retentive subsoil ;

(4) Depressions in hill sides which hold water coming from land above as by seepage ;

(5) Irrigated lands, rice fields, etc., where excess of water is applied and must be removed ;

(6) Alkali lands under irrigation to remove injurious salts ; and

(7) Areas where canal irrigation distributaries have to be carried across permeable soil.

Benefits of drainage.—The benefits of drainage consist in improved soil, plant and water relations. Drainage increases crop production enhances the value of wet lands, improves the health and sanitation of such tracts, aids transportation and promotes the general development of the country.

Drainage improves the productive capacity of the soil for the following reasons :—

(1) It removes excess water, lowers the water table so that larger pore spaces may contain fresh air ;

(2) It increases the capillary supply of moisture, since drained soil is in a better state of tilth than undrained and contains more moisture in times of drought ;

(3) It improves soil structure and facilitates cultivation at the proper time, checks growth of weeds and increases the outturn of crops ;

(4) It deepens feeding areas for plant roots by lowering the water table, and consequently reduces suffering during periods of drought ;

(5) It admits fresh air to soil and roots and facilitates circulation of air in the soil;

(6) It raises the soil temperature and permits of better germination of seeds;

(7) It increases chemical action by assisting decay and nitrification;

(8) It prevents erosion and consequently retains the fertility of the soil; and

(9) It prevents the rise of alkalies since excess soluble salts are kept moving down and out through the drains.

Need for drainage in India.—The removal of excess water from areas enumerated above so as to bring under cultivation wet and water-logged areas, otherwise fertile and advantageously situated, is a matter of very great importance in providing food and house sites for the increasing population of a country.

Methods of drainage.—Drainage consists essentially in the direct removal of gravitational water from the root zone of the soil, by providing free passage for its percolation and flow and thus artificially removing excess soil water.

The different kinds of soil drainage can be classified as follows:—

(1) Natural drainage, through gravelly subsoil and surface run off;

(2) Artificial drainage, through (*a*) open or surface drains, and (*b*) underdrains or subsoil drains. Both these have their own advantages and disadvantages.

Open drains remove water from the surface and to a certain extent from the subsoil as well, the latter depending upon their depth, gradient and amount of water in the channel. Surface drains are useful where large volumes of water near the surface have to be removed and where drainage is temporary. They are also used as outlet ditches for receiving the discharge from tile drains. Surface drains cannot be made sufficiently deep, and are likely to get silted up very soon. They are expensive to maintain since expenditure has to be incurred annually for clearing silt and removal of weeds; they are also uneconomical as much cultivable land is taken up by these drains and they interfere with cultural operations and movement of machinery. They are also

likely to be subjected to erosion. Thus, though surface drainage may be cheaper in initial outlay yet, in the long run, it will be more costly than underdrains, considering the annual maintenance charges and loss of land.

The system of covered drains is the only complete and fairly permanent form of drainage. The entire field is available for cultivation, cultural operations can be carried out uninterrupted, agricultural machinery can very conveniently and easily be moved from one end of the field to the other, growth of weeds is controlled, annual upkeep charges of open drains is done away with and the system is more permanent and efficient.

Principles of drainage.—The value of underdrains depends upon the free passage of water through them. The lateral or side drains must be made to flow into the main drain and all must be gradually sloped to secure a uniform flow of water through them. The spacing and depth of the drains depend upon the nature of the subsoil—deeper and farther apart in the case of light soils and shallower and nearer together in the case of heavy soils. Since underdrains have to operate in the subsoil, the subsoil strata must be tested by a soil auger and the tiles must be located in the free-working soil, avoiding as far as possible the heavy strata.

(*To be continued*)

THE PROBLEM OF PROVIDING FOOD FOR THE GROWING POPULATION OF INDIA

BY N. P. DESHMUKH

(*Senior B. Ag.*)

Introduction.—India is one of the oldest and most densely populated countries, containing a fifth of the total population of the whole world. The population of India is increasing steadily, though not so rapidly as in some of the Western countries. About 75 per cent of the people in India are directly dependent on agriculture. The continuous increase of population and the consequent pressure on land have brought about a state of chronic poverty in India. It is a well-known fact that few people in India enjoy the pleasure of two full meals every day. It is a matter of common knowledge that millions of people in India are barely above the mediæval in their standard of living.

The following table calculated on the basis of the figures for 1890—91 to 1900—01 will show the progress of population and food production in India :—

Year	*Population*	*Net area sown*	*Area under food crops*
1890-91 to 1900-01	100.00	100.00	100.00
1900-01 to 1910-11	105.62	110.99	108.11
1910-11 to 1920-21	106.92	115.18	111.89
1920-21 to 1930-31	117.74	117.80	114.05

Although the net area sown has kept pace with the growth of population the area under food crops has lagged behind. The dependence on agriculture has been steadily increasing during the last four decades with the result that the cultivated area per head of population has been steadily falling. Agriculture has not shown any appreciable improvement and the yield per acre has not increased. India does not import any food nor could she afford to do it. The following table will illustrate this point:—

Year.	Total population of British India (millions)	Total cultivated area of British India (millions of acres)	Cultivated area per head of population (acres)	Percentage dependent on agriculture	Cultivated area per head of agricultural population. (acres)
1891	221	194	0.88	61	1.44
1901	231	197	0 85	66	1.26
1911	244	216	0.88	71	1.24
1921	247	212	0.85	73	1.17
1931	272	225	0.827	...	...

Shortage of food in India.—From the data available for the year 1927—28 let us see if the food supply in India is sufficient or not to meet the requirements of her huge population. The figures are calculated roughly on the lines shown by D. S. Dubey in his article on "Food Problem in India" in the *Agricultural Journal of India.* The total outturn of food crops for that year was about 70.94 million tons. Allowing 10 per cent for wastage the quantity available for consumption comes to nearly 63.85 millions of tons. The population for the year can be approximately taken as 338 million. The quantity of food grains and pulses required by the whole population to maintain

them in health and strength works out at 55.71 million tons. Taking into consideration the quantity of food grains consumed by the cattle and the quantity required for seed, the total requirements work out in the neighbourhood of 73.95 million tons. But the quantity available for consumption is only 63.85 million tons. So there is a deficit of about 10.10 million tons for the year 1927—28.

This has more or less been the normal state of affairs in India since a very long time and it is borne out by the investigations of several students of Indian economics in the past.

Sufferings of the people due to shortage of food.—Food being a vital necessity of life, the importance of the problem cannot be over-estimated. The immensity of the evils that emanate from the dearth of nourishment for the body is too apparent to require mention here. But briefly it may be stated that the low vitality, early death and high infant mortality amongst Indians are the result of the above-mentioned evil.

The necessity for increasing food supply.—The country cannot make progress in any way while this evil lasts. The above-mentioned facts bring into prominence the urgent necessity for taking up in right earnest the problem of increasing India's food supply.

A shortage of food supply can be made good in one of three ways, *viz.*, by importing food, by increasing the area under food crops, or by a more intensive cultivation of the land already under cultivation.

The question of India meeting her shortage of food by importing food from other countries is not practical politics. Agriculture is the main industry of this country and the shortage of food is an evidence of under-production. Where is the money for buying the foodstuff to come from? It is all right for England to buy her food from other countries, because she produces annually an immense amount of wealth by her manufacturing industries and she can buy her foodstuff with a part of that wealth. That apart, it is very dangerous for a nation to depend upon others for her food supply, particularly when she has all the facilities for raising it in her own country. It is extremely foolish for any one to think that the shortage of food in India can be met by importing foodstuffs from other countries.

Extending cultivation.—How about increasing the area under cultivation? A glance at the figures of land utilization in India will show that only about one-third of the total area is sown with

crops. About 7 per cent of the area goes under fallow every year and about 22.7 per cent is culturable waste. Thus it will be possible to extend cultivation to over two hundred million acres of land. But the prospects in this direction are not so bright as they at first appear.

All the best lands have already been utilized for cultivation. What remain are inferior grades of land. Breaking this inferior land to cultivation involves the clearing of jungles, provision of irrigation and transport facilities, etc., all of which mean heavy outlay of capital which is a very difficult task in the present state of agricultural credit in this country. Thus the chances of extending cultivation to new areas are not very many and the relief must be sought elsewhere.

Intensive cultivation.—Indian agriculturists follow methods of extensive cultivation which are unsuitable for a densely populated country like India. The result is that the outturn per acre is very poor. Contrasting Indian conditions with those of Japan in this respect Sir M. Visvesvaraya writes: "Japan, although not self-sufficing in the matter of food, maintains normally a population of fifty-six millions on a cultivated area of seventeen millions, or one-third of an acre per head, as against India's five-sixths of an acre." Agriculture is carried on in Japan and China very intensively and thoroughly, almost like gardening. While Japan can maintain her population only with one-third of an acre per head can India not meet her food supply with even five-sixths of an acre per head? Certainly, India can be self-sufficient in the matter of food supply if she takes up intensive cultivation seriously. But there are a number of serious difficulties in the way of adopting intensive methods of cultivation in India.

Consolidation.—The scattered and fragmented nature of the holdings in India is a great impediment to the adoption of intensive methods of cultivation. Fencing is not possible; digging of wells becomes uneconomical; and growing of a second crop becomes impossible when the whole village area is converted into a temporary grazing land for cattle. In fact, all problems about manures, machinery, labour, are ultimately connected with the size of holding at the disposal of the cultivator. The evil can be remedied considerably by consolidating the scattered holdings which will enable the cultivator to have all his lands in one block which will facilitate fencing, digging wells, etc. Consolidation alone will bring about an increase of about 15 per cent in outturn by dispensing with unnecessary *bunds*, and boundaries and by avoiding unnecessary corners.

Irrigation.—Irrigation is an absolute necessity for intensive cultivation. Wherever irrigation is possible, intensive cultivation can be adopted. To increase the food supply, double cropping will have to be resorted to. This can be achieved only by the judicious combination of irrigation and intensive cultivation. Indian agriculture is mainly dependent for agricultural production upon rainfall. The rainfall, however, is unequally distributed and precarious. It may be in excess in one year and might altogether fail in another year. The vagaries of Nature can be remedied by irrigation alone; and the parts which are susceptible to such vagaries can be made to increase their food supply by means of irrigation. At present only about 20 per cent of the cultivated area is irrigated. The introduction of co-operative principles in the construction, maintenance and administration of irrigation works must be achieved as it has a direct bearing on the supply of irrigation water and this ultimately would lead to increase of food supply.

Use of manures and fertilizers.—For intensive methods of cultivation application of manures and fertilizers in proper quantities consistent with the nature of the soil and the crop is highly essential. Judicious application of manures and fertilizers in accompaniment with irrigation will increase the food supply immensely. One of the wasteful practices to which people in India are addicted is the use of cow-dung as fuel. This tendency should be discouraged. From the several analyses carried out of Indian soils it is shown that the soils lack primarily in nitrogen and secondarily in P_2O_5. It will be unwise to expect any increase in food supply from the soil unless the deficiency of the above-mentioned important ingredients is made up. The rice tracts in India are found to be deficient in P_2O_5 and experiments have shown that by supplying P_2O_5 in the form of superphosphate or bone meal according to circumstances, the yield of rice is enhanced considerably. It is already shown that most of the Indian soils are deficient in nitrogen. Fertilizers like ammonium sulphate and sodium nitrate are being recommended after testing their efficiency in giving increased outturns.

Capital.--No industry can thrive without capital. For the purpose of improving agriculture and increasing the food supply of the country large amounts of capital are required. The capital requirements of agriculture fall under two heads: (1) Long-term loans for land improvement, and (2) short-term loans for working expenses. Land in India is as Nature made it. It is quite impossible to obtain increased food

supply from such lands unless some improvement in the form of embankment, fencing, drainage, grading, levelling, etc., are made. All these improvements involve the investment of large amounts of capital. The farmer also requires capital for working expenses, *e.g.*, buying seed and manure, paying the labour charges, etc. Unless he has capital for meeting the working expenses he will not be able to carry out his operations in time, which will result in failure of crops. So, furnishing easy capital both for land improvement and working expenses will help a great deal in increasing food supply.

High-yielding varieties.—Substitution of high-yielding varieties in place of low-yielding ones will go a long way in increasing food supply. Recently the science of plant breeding has made a great advance. By means of hybridization and selection many high-yielding strains of different crops have been produced. As an example we may quote here some of the varieties of wheat like A. 112, A. 113, A. 115, so also Pusa Nos. 4, 12, 52, 54, 100, etc. By the introduction of such improved and high-yielding varieties the food supply can be raised enormously even with the existing acreage.

Organization.—Organization, which is perhaps the most important factor in the success of any business, has not yet been introduced into agriculture to any appreciable extent in India. Agriculture is as much in need of organization as any other business. Co-operation among farmers can go a long way towards solving some of the problems and removing many of the difficulties. For instance, farmers may combine to purchase improved implements and machinery like ploughs, harrows, winnowers, threshers, tractors, for their common use or they may combine for constructing wells for irrigating their fields. By co-operation in these matters the cost of production will be considerably reduced.

For providing marketing facilities and for the efficient distribution of foodstuffs, cheap and rapid transport is essential. Development of communications in rural areas will indirectly help a great deal in increasing the food supply.

Alternative sources of food supply.—In addition to all these methods of increasing the yield from the soil, we must also try to explore other alternative sources of food supply: Fisheries may be developed with great advantage to supplement the food raised from the soil. The people inhabiting the banks of rivers and sea coasts can

safely undertake this alternative occupation. In those places fish can supplement food grains. Another alternative source of food supply may be found in raising new crops other than those that are commonly grown. China feeds her teeming millions on soy-beans and it may be profitable to introduce the same into India. Germany has taken to root-crops. In Malabar tapioca has become very popular during the last thirty years.

It is no exaggeration to say that the problem of food supply is a life and death problem for Indians and as such it deserves the best attention on the part of those who are interested in the welfare of the country. It must be borne in mind that a starving nation can achieve nothing in the world.

Extracts

INDOOR FRUIT ORCHARDS

BY. A. N. MIRZAOFF

Strange as it may seem at first thought, it is entirely possible to raise in the home mature fruit trees that bear as regularly and plentifully, in proportion to size, as those of the outdoor orchard. On the dining room table or a nearby window shelf, a large flower-pot may be placed to hold the soil which supports a fully matured fruit tree—apple, pear, peach, and so on—which differs from its brothers of the orchard only in size.

One of the ever-interesting features of Japanese horticulture is the miniature landscapes which are familiar to all. Displayed in the windows of Japanese novelty shops and florists, these tiny gardens never fail to excite curiosity. Here are tiny houses, surrounded by beautifully landscaped grounds, all within an area of a few square feet.

It is not surprising, then, that the Japanese, in order to carry out their miniature landscape gardening with the utmost realism and fidelity, have developed a method of propagating dwarf trees for this purpose. The whole system of culture of these tiny trees may be summed up as the reversal of nature's own method. It is based on the survival of the unfittest, so to speak, rather than on the survival of the fittest.

A little over 75 years ago a Japanese gardener landed in Southern France and secured a position on a large estate in that country. Five years later, this Japanese gardener was known to every landscape artist and to every horticulturist through Europe. So many wonders had he performed in dwarfing pine trees, that he accumulated a fortune as a consultant in horticulture. The secret, however, he never disclosed but other horticulturists began studying his work. In less than a decade, what the Japanese horticulturist believed was his own secret was a secret no longer. A French horticulturist then introduced a method of dwarfing that had for centuries been kept secret by the masters of China and Japan. By the Japanese, this method of dwarfing trees is called "tsukurimono". It was at first exclusively restricted to the dwarfing of a number of various varieties of pine and spruce trees, and no attempt was made to dwarf fruit trees until recently.

As we walk through a forest we see that some trees grow to gigantic proportions, while others of the same family seem weak, undernourished and puny. The rocky slopes of mountains supply little moisture and less plant food; therefore the young plant, deprived of its natural share of nourishment does not thrive so well here as the tree that grows in rich soil on the lower slopes. Here the trees receive the benefit of sun and the richness of soil and grow to be fine specimens of their family. With the right amount of sun, the proper kind of soil, and the proper amount of moisture, spruce and pines grow to magnificent proportions.

Now that the basic facts are known as to why some trees grow large and other trees of the same family fail to attain the proper proportions it is a comparatively simple thing to grow stunted trees in your own home.

The method of dwarfing consists of continual pruning of the roots combined with cutting of the branches to induce more compact foliage and to prevent the loss of too much moisture. Where dwarf fruit trees are to be raised in flower-pots the method becomes slightly complicated. Fruit trees do not bear fruit properly unless they are grafted, hence before planting any fruit trees in flower-pots we must first have the grafted trees.

Suppose, for example, you desire to dwarf an orchard of peach trees. You can buy the small trees from a nurseryman or you can plant peach stones from well-ripened fruit of good quality. If you wish to

buy the plants see to it that they are not more than two years old. Be certain also that the trees which you purchase have been grafted. The third year they are transferred to the flower-pots. It is then that the real work of dwarfing begins.

Surgical methods are applied, first by cutting out the tap root which usually grows in the centre of the plant. This is best done by the so-called strangulation method. Fine picture wire or for that matter any small wire is tied at the base of the root and the process of strangulation will be completed in a couple of months. This prevents the tree from taking too much nourishment and its growth is therefore retarded.

Meanwhile, some of the branches with excessive leaf growth are pruned in order to prevent too much evaporation of moisture through the leaves. In the treatment of the soil very little nourishment is provided—just enough to keep the tree alive but not enough to cause rapid growth. A few pebbles scattered in the dirt will prevent the roots from growing thickly.

The fourth, fifth and sixth years the same surgical operations are continued, either in early spring or in the late fall, until it is evident that the tree no longer has a tendency to rapid growth and gradually settles down to increase the thickness of its main trunk, which is the sign of ripe age. At this stage the tree commences to bear healthy fruit on the few branches that are left for its existence.

The dwarfing characteristics can be perpetuated artificially by the so-called vegetative method of propagation. The bark of a branch is slit a number of times and soil is bound around the injured part for a space of four to five inches. Around the soil, place plenty of thick moss. Tie with a string and keep the soil moist at all times until roots have formed. Then cut at the base and plant in fresh soil in a flower-pot. The cutting need be made by this means only if one wishes to develop a great number of dwarf offsprings of fruit trees.

The rewards obtainable from growing dwarf trees will more than pay for the time, the care, the patience necessary to grow them successfully, because the fresh fruit picked from your own orchard growing right in the home will make you feel that you have really produced something worth while.—(*Scientific American*).

PREPARATION OF CHEAP MANURES

II. Preparation of Artificial Farmyard Manure*

As a result of the recent research work of the Rothamsted Experimental Station, England, it has been found that farmyard manure can be manufactured from various vegetable waste materials without the help of the farm animals, and if the cultivators are careful enough to collect all the vegetable waste material from their fields and surroundings and convert it into useful organic manure, the fertility of their fields will be greatly increased and the deficiency caused by the use of cattle-dung as fuel will be made good to a very great extent.

Method of preparation.—Various materials like cotton stalks, pigeon-pea (*tur*) stalks, weeds, fallen leaves, sannhemp, *ambidi* stalks, etc., are usually available in large quantities and the cultivators can convert these into useful and quickly available manure which compares favourably with the natural farmyard manure obtained from cattle-dung.

The available waste material, where necessary (*e.g.* in the case of of hard stalks), should in the first instance be cut into as small pieces as possible. This can be done by passing the material through a fodder cutter if one is available or in the alternative by using the material as bedding for the animals and by spreading it on cart tracks on the farm. By the continuous trampling down of the material by cattle and the cart traffic, the woody material will be soon crushed down without much extra expense and where the material is used as bedding for the animals, it will get the additional advantage of being partially saturated with cattle urine. When the raw materials are converted into a reasonably fine condition the following procedure should be adopted :—

1. Dig a pit measuring 10′ x 10′ x 6 inches or one foot.
2. Spread loosely the available waste material prepared as directed above, till the layer is one foot thick.
3. Spread evenly one-fourth of the following mixture and a small quantity of well-rotted cattle-dung to introduce the required organisms which convert the waste material into manure :—

Ammonium sulphate	...	20 lbs.
Ground lime stone or lime kankar	...	30 lbs.
Superphosphate or bone compost	...	20 lbs.
Total	...	70 lbs.

* From a leaflet issued by the Department of Agriculture, C. P. & Berar.

The various ingredients should be thoroughly mixed before use. Superphosphate can be omitted if necessary and if sufficient cattle urine is available about 40 to 50 gallons of urine can be sprinkled on each layer of the raw material instead of ammonium sulphate. Twenty lbs. of nicifos grade II can also be employed instead of the ammonium sulphate and superphosphate given above. The quantity of ammonium sulphate given can be increased to 40 lbs. in order to quicken the process of decomposition particularly in the case of woody stalks.

(4) Moisten the layer with sufficient dung water. (Dung water should be prepared by thoroughly mixing the dung with 25 to 50 times its weight of water).

(5) Repeat the above operations Nos. 2, 3 and 4 till you have got four layers of the waste material and the total height of the heap is four feet.

(6) Water the heap from time to time afterwards in order to keep the moisture content to about 70 to 80 per cent. Whenever you thrust your hand inside the heap you should feel the material quite wet. This would roughly show that adequate water supply is present. It would be convenient to collect the raw materials in the summer and get them crushed as fine as possible where necessary and start the operations of composting in the rains when there is no scarcity of water.

(7) The heap should as far as possible be protected from excessive rain and sun by means of a *kachha* shed.

(8) In the case of leafy material, artificial farmyard manure will be ready in about three to four months' time, but in the case of other woody materials such as cotton and *ambadi* stalks a longer time will be required. When a sample drawn from the heap resembles farmyard manure, the product can be taken as ready for use as manure.

(9) When once a certain quantity of artificial farmyard manure is available, small quantities of this material can be used as a starter instead of the well-rotted cattle-dung mentioned under (3) above.

Notes

SUGAR INDUSTRY IN INDIA

The Sugar Industry Protection Act passed by the Indian Legislature in last April is expected to give a great stimulus to the languishing sugar industry of this country. The Act however has not come a whit too early. For it was recently reported in the papers that sugarcane-growing in U. P. has reached a very critical stage o·ving to lack of adequate facilities for making use of the entire sugarcane grown in that province over an area of 1,600,000 acres. The price of sugarcane has fallen and it is expected will soon go below cost of production if immediate steps are not taken to establish sugar factories at suitable centres. The stimulus given by the new Act has already begun to show itself and twenty-four new sugar factories are expected to start working in Northern India during the course of this year. There is a wave of interest and feeling of confidence all over the country regarding the chances of developing the sugar industry and many more factories are expected to come up in other parts of India too. In the meantime, there is a move to expand the area under sugarcane in Bombay and Madras, particularly in the latter presidency where it is expected the area will be increased considerably during the current year. The new early variety of sugarcane maturing in six months produced by Rao Bahadur Venkatraman, the Imperial Sugarcane Expert, by crossing sugarcane and sorghum, is expected to carry this crop to areas where it cannot now be grown on account of the absence of suitable irrigation facilities. There is considerable scope for expanding sugarcane even in our own province and if modern methods of cultivation and *gur*-making are adopted by the growers, sugarcane will be a source of great profit to a large section of the cultivators in possession of suitable land and irrigation facilities in this province. India is annually importing nearly a million tons of sugar valued roughly at 15 to 20 crores of rupees, mostly from Java. It is hoped that before long India, the original home of sugarcane, will become self-sufficient in the matter of sugar.

IMPROVING INDIA'S TILLAGE IMPLEMENTS

Mr. Donald J. Beaton, Agricultural Engineer, Satara, has published a scheme for the development of Indian agriculture and its allied industries. Mr. Beaton hopes that if his scheme is adopted it will increase the productive capacity of the country by a thousand crores of rupees. According to him the

manufacture and distribution of crude wooden implements by the village artisans is mainly responsible for the present state of agriculture in India. In his memorandum entitled "The wholesale introduction of improved tillage implements in India" Mr. Beaton outlines a five-year plan of research in agricultural implements. His objective is to put on the market 3 million improved ploughs per annum at a reasonable cost and entirely independent of any financial assistance from the Government. He would also establish a "Bureau of Tropical Engineering and Technological Research" which would be financed by royalties and cesses payable by those who would eventually reap benefit—the mass production factories. Mr. Beaton proposed to place copies of his memorandum before the Imperial Economic Conference at Ottava and also before the Advisory Board of the Imperial Council of Agricultural Research.

The scheme is not lacking in boldness. It remains to be seen how far it will materialize.

CO-OPERATIVE MARKETING IN MADRAS

Mr. Ramamurthi, Director of Agriculture, Madras, in a statement to the Press gave the outline of a proposed scheme of co-operative marketing for groundnut in South Arcot District. The District has about 4 lakhs of acres under groundnut. It was found that the groundnut crop in the district was sold mostly in December with prices at Rs. 25 a candy while during March and April prices were nearly double. Not being able to wait for three or four months the groundnut growers of the district lost nearly a crore of rupees in the sale of groundnuts. Again, the cultivators found the necessary finance for cultivation, etc., from the money-lender which imposes an obligation to sell the crop to him at rates and under conditions wholly unfavourable to the grower. The main problem is to finance the growers for cultivation and for holding the stock for a rise in price. In future, this financing will be done by the co-operative societies on the recommendation of the agricultural demonstrator of the locality. The latter should watch that the loans given are applied to the cultivation of groundnut only. The cultivators who take loans from these co-operative societies, agree to sell their crop to a Central Co-operative Loan and Sale Society. The Central Society may advance money on the security of the stock received. When the produce is sold the amount of the loan, whether taken for cultivation or on the security of the crop, is deducted and the balance

paid to the *ryots*. The Central Society is situated at Cuddalore and makes use of motor lorries for the transport of the produce and they have also expert assistance for grading the produce before sale.

BRIGHTENING UP THE COUNTRY-SIDE

How to provide the amenities of modern life for the rural dwellers who constitute 90 per cent of the population of India is a very serious problem confronting those engaged in nation-building in this vast sub-continent of nearly 700,000 villages. It is highly necessary that life in these villages should be made more pleasant and attractive so that the educated and moneyed class might stay there and develop the villages. Recently a movement was started in England for the brightening up of the country-side and the movement is gaining ground every day. His Royal Highness the Prince of Wales lately blessed the movement by undertaking a tour in the villages of Nottinghamshire. Addressing the villagers, His Royal Highness said " Agriculture and the social aspects of life in the country are parts of a single whole and cannot be divorced. Bad agricultural conditions depress the standards of village life and bad social conditions react inevitably on agricultural efficiency ". " Those activities which bring zest and keenness into the life of the villagers," proceeded His Royal Highness, " have a direct influence on agricultural prosperity and for that reason alone are well worth encouragement ". Referring to the necessity for creating an interest amongst the rural population His Royal Highness said, " the Scots showed long ago that the man was not the worse shepherd because he studied philosophy and if sailors are helped to go about their work by singing shanties, a ploughman will drive a furrow none the less straight if in the evening at a dramatic society he takes a part in one of Shakespeare's plays ". His Royal Highness said that the chief enemy to progress is apathy. " Apathy is worse than depression because depression can be dispelled by action. If people who deplore what is wrong in village life, would face up to it and get busy they would soon find that with apathy out of the way they would cease to be depressed ". We hope that our rural workers will find guidance and encouragement in these words.

A NEW IRRIGATION PROJECT

The Nizam-Sagar Irrigation Barrage Scheme, which is fast approaching completion in Hyderabad, is one of the biggest irrigation schemes in the world. The Barrage forms a reservoir of nearly 60 square miles in area when filled to

its maximum capacity. It is capable of irrigating over 1,000 square miles of land. It will have about 96 miles of main and branch canals and over 600 miles of distributary canals.

The Barrage is built on the river Mangra which has sufficient water to irrigate over 600,000 acres of land while the reservoir, when full, is estimated to have a capacity of 29,700,000,000 cubic feet.

The gigantic nature of the project can be realized from the fact that at times over 20,000 men were employed on the Reservoir works and about 12,000 men on the main canals. 55 miles of light railway had to be laid for bringing materials. The approximate cost of the whole scheme, including all the main and subsidiary canals, is stated to be about £3,000,000 and it will irrigate about 275,000 acres of land. It is estimated that the net return will be about 10.8 per cent on the capital outlay while the Government irrigation works in British India taken as a whole yield only a return of 5½ per cent on the capital outlay.

College News

The heavy and continuous downpours of rain during July and August made regular field practicals impossible. The *Khariff* crops—and particularly cotton—have not been very promising owing to water-logging and growth of weeds during the early days. The second year garden crops are however better.

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Mr. B. B. Dave has been appointed as Junior Botanist for Rice Research at Raipur. We offer our hearty congratulations to Mr. Dave on his promotion.

Dr. R. J. Kalamkar, an old boy of our College, has been appointed as professional Assistant in the Meteorological Research Station at Poona. We understand that Dr. Kalamkar will be engaged in the study of the influence of weather conditions on the growth of crops. This is a new line of work as yet unexplored in India. We congratulate Dr. Kalamkar on his appointment and wish him good luck.

Hostel News

A "STUDENT'S BENEFIT STORE" has been opened in our hostel under the auspices of the "Poor Students Fund Society." The Store supplies all articles of daily use in demand by the Agricultural College students, at market rates. The students are requested to purchase all their necessaries from the Store and thus encourage the venture. The capital so far raised by selling Shares is little, compared with what is actually required to run the Store on a good scale; hence the students and the members of the staff are requested to purchase more Shares and thus help to increase the capital. The rules of the Store and the Shares can be had from Mr. D. N. Gour, the Secretary.

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Our hearty welcome to Mr. S. K. Mishra, our new Assistant Superintendent. Mr. Mishra is no new person to us and we have no doubt that he will soon be a very popular figure in our Hostel life.

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Janmashtami Celebrations.—The birth of our Lord Krishna was celebrated on the 24th August. Unfortunately this festival happened to coincide with the quarterly examinations of the second and fourth-year students. Nevertheless it was conducted with the usual *éclat*. Mr. Athwale and others provided an excellent musical entertainment in the night which was attended by all the students and also some members of the staff. We wish to take this opportunity to thank all those who helped to make the function a success.

Ganesh Festival.—It was feared in the beginning that financial considerations would affect the scale of the celebrations. Very fortunately, however, this was not the case. The management had for its secretary one who has taken since his term in this College the keenest interest in decorations and whose skill in making decorative cuttings in paper is admirable. Mr. J. G. Bhalerao, though a student of the IV year class, and as such labouring under various disadvantages, proved a very efficient Secretary.

During the festival week we had amongst us some of the eminent citizens of Nagpur. Mr. Hidayatullah, Prof. Sinha, Mr. Inayatullah Khan, Swami Bhaskareswarananda and Dr. Jha spoke to us on different social and religious subjects. Messrs. Bhattacharya, Krishnamurthy, Athawale and the boys and girls of Shriram Sangit Vidyalaya gave us excellent musical entertainments, for which we are very grateful to them.

Throughout the celebration our Director, Mr. F. J. Plymen, C.I.E., and our Principal, Mr. J. C. McDougall, displayed keen interest which was very

encouraging. In the usual Ganesh Feast our Principal proved an attractive figure squatting in our very midst.

The management thank all the members of the staff and students for their co-operation in bringing the festival to a successful close.

The College Debating Society

The following office-bearers were elected at the first meeting of the Society:—

President—Mr. J. C. McDougall, M.A., B.Sc.
Vice-President—Mr. H. P. Dwivedi
Secretary—Mr. H. Misra
Joint Secretary—Mr. T. P. S. Chaudhary

Members of the Managing Committee:—Messrs. P. V. Bhagwat, D. N. Gour and H. B. Mishra.

Under the auspices of the Society three extraordinary meetings were held. In the first, Dr. R. J. Kalamkar, an ex-student of this College, delivered a lecuture on "Modern methods of field experimentation." In the second, Mr. Venkiya of Betul Farm lectured to us on "The Cultivation of Sugarcane in Betul." Both the lectures were of special value to Agricultural students. In the third extraordinary meeting Rev. J. Z. Hodge of the National Christian Council lectured to us on "Rural reconstruction." His lecture was highly interesting and educative. Rev. Hodge has kindly promised to speak to us again shortly on some of the practical aspects of the question.

The King Edward College Debating Society arranged for a friendly debate with our College during the visit of our teams to Amroati to play the inter-collegiate matches. The subject of the debate was "In the future constitution of India women should be given equal rights with men." Messrs. S. C. Bhattacharya, A. M. Chaudhary, H. B. Mishra and T. P. S. Chaudhary represented our College, the first two speaking in favour of the resolution and the last two against. The resolution was moved by our College. The debate was a very keen one and the motion was finally carried by the house. We offer onr thanks to the Principal, staff and students of the King Edward College for their cordial hospitality.

The College Gymkhana

Owing to continuous rains the season was altogether unfavourable for the pursuit of cricket, hockey, foot-ball or tennis. The secretaries for the above games did their best to get into form as soon as the rains ceased. But an eleventh-hour attempt could not render the teams fit for a keen test, with the result that they had to yield place to the King Edward College in the University Tournament.

We have some good foot-ball players and with proper practice they should do well. Almost the same thing can be said of our cricket team too. The recent extension of the playgrounds provides a separate hockey field and now foot-ball and hockey can be played side by side. We hope our players will take advantage of this in the coming months.

The addition of a new court has given greater opportunities for our tennis enthusiasts. We hope the students will join the Tennis Club in larger numbers.

Gleanings

Wood Preservation.—Dr. Kamesan, Wood Preservation Expert to the Government of India, has invented a new method of treating timber by injecting arsenic into it. Timber so treated can be preserved for twenty to thirty years. This process known as Fal-Kamesan process is said to be much cheaper than the creosote process, costing only an anna per cubic foot. Jungle wood so treated could be used for constructing bridges in preference to steel and concrete. In America several railway bridges have been constructed out of preserved wood and with great success. This new process is said to be of considerable economic advantage to some of the provinces in India where little teak is grown and the jungle wood remains unused at present on account of its inferiority.

The Evil Eye.—Who has not heard of the evil eye and the miraculous touch? Educated persons refuse to believe in them and consider them as creations of the imagination of superstitious people. But here is science supporting these ancient beliefs. Otto Rahn of Cornwall University claims to

have discovered human radiations powerful enough to kill bacteria. Experiments were made with yeast cells on a glass plate and when approached by a person—in the experiments a woman—they died. When covered with a glass opaque to ultra-violet rays the glance of the woman had no effect. Even more startling was the discovery of the same emanations from the fingers. One woman cannot touch flowers without causing them to wilt. Dr. Rahn believes all persons to some degree send out such radiations, the force varying according to individuals and not according to sex.

The Value of Red Squill Powder in Rat Control.—The value of red squill powder in the destruction of rats is becoming increasingly recognized. When experiments were carried out in the Zoological Gardens in London some years ago, it was found that the liquid preparation of red squill (a liliaceous plant known also as scilla and sea-onion, *Urginea maritima*) was more trustworthy than powder mixtures. Since 1923, however, the United States Department of Agriculture has been experimenting with the powdered forms and it has been found that a powder of maximum toxicity can be obtained by drying the sliced bulbs at a constant temperature of 80° C. Thus the greatest difficulty in the use of red squill, irregularity of results, has been overcome, and the poison has become the most widely used against rats in the United States. It is greatly in its favour that this rat poison is relatively harmless to human beings and domestic animals ; indeed, in field tests, prairie dogs and pocket gophers refused to eat the red squill baits and in most cases cats, dogs, chickens, pigeons and pigs either refused to eat poisoned goods, or, having eaten, promptly vomitted them. One of the authors of the United States Department of Agriculture Leaflet, 65, "Red Squill Powder and Rat Control" himself swallowed 15-grain and 40-grain doses of a toxic red squill powder without untoward results.—(*Agriculture and Live Stock in India*).

Simple Rules for Cleaning Milk Vessels.—Every investigation that has ever been conducted has indicated that quality of milk depends more on clean milk containers than on any other one factor. Clean milk pails and cans are more important than clean stables, clean cows or even clean men, important as all these latter are. The keeping clean of these utensils is boiled down into most concise form by the Ohio State University as follows:—
1. Rinse with clean water immediately after the utensil is used. This rinsing removes a large amount of the milk before it dries. 2. Use hot water containing a dairy washing powder. Use a brush and not a cloth for scrubbing. 3. Rinse with clean, hot water. 4. Sterilize with steam, boiling water or a hypochlorite solution.—(*Agriculture and Live Stock in India*).

Care of the Separator.—The operation of the separator and the care devoted to its cleansing have a material effect on the quality of cream produced. On no account should the separator be left overnight without being dismantled, and all parts thoroughly cleansed and scalded. After separating, all utensils and separator parts with which milk has come in contact, including the vats, buckets, and strainer, should be washed with slightly warmed water and then submerged in boiling water and placed on racks to drain. The practice of wiping over the utensils with a cloth after scalding only serves to undo the work of sterilization and to re-infect with bacterial organisms.

Milk should not be left lying about on the floor or under the separator block, and the surroundings should be kept sweet and clean, and the drains free to carry away the floor washings.—(*Queensland Agricultural Journal*).

Making good use of Beastings (*Colostrum*).—The first milk from the cow after calving is called beastings, and is not made the best use of on many farms. It is really the very essence of milk, and contains more nutriment than any other taken from the cow. It is especially provided for the calf's first meals; for being of a slightly purgative nature it clears off all abnormal or rather offensive lodgments from the stomach and bowels, and at the same time brings the internal organs into proper action, so that it should be the herdsman's first object to get the newly born calf to take a free sup from the udder. It is, however, the general practice to wean the calves from their mothers immediately after parturition and deprive them of the beastings with which they should be served. Though ordinary new milk may, and likely will, contain a good percentage of butterfat or cream, it will not contain colostrum (beastings), hence it is that numbers of calves are lost in the early days of their existence from scour or some other disorder brought about by injudicious feeding.

Rearing calves may always have their ordinary meals improved with the rich first milk, and when it is used no cake or bought meals are needed. It may also be given to pigs to improve their ordinary meals.

The duration of the beastings state of the milk depends on whether the animal be a heifer or a more aged cow, and of a rich milking breed or otherwise. Cows that have had a number of calves and never were famed for the richness of their milk, only give about one or two meals, while heifers of such high-class milking breeds as Channel Islanders continue to give the rich meals for two or three days. Naturally, the food and condition of the cow have something to do with the duration of this state of the milk. The cow highly

fed on good milk-producing food will give beastings for a meal or two longer than if she were kept on poor food, just the same as the kine calving when fat have a tendency to give them for several meals longer than poor lean cows.

The beastings are not fit for panning nor may they be set for skimming, because the cream does not rise. Many a dairymaid has longed to turn it into butter, but mixing beastings with ordinary new milk has spoiled the whole pan. The day after the beastings state has passed away the milk may be panned in the ordinary way, and will give the richest cream and the best of butter, other things being equal.—(*Queensland Agricultural Journal*).

Transplanting Fruit Trees.—The transplanting of partially developed fruit trees is seldom attempted on account of the risk of failure and the trouble entailed in endeavouring to retain sufficient fibrous roots to ensure a reasonable prospect of success. Trees up to five or six years old, where subject to the necessary preliminary treatment, can not only be removed without risk of failure, but transported satisfactorily over long distances. It will be recognized that the sustenance of the plant is absorbed by the small or fibrous roots in the immediate vicinity of their terminals, and by inducing a profusion of these within a short radius of the stem the chances of failure are practically nil. A profusion of small roots may be ensured by cutting through at the desired distance from the stem (15 to 24 inches, according to the size of the tree) all roots to a depth of 18 inches. In so doing a trench is made around the tree and the ends of root carefully pared if the cutting has not been " clean." The trench is then refilled with soil containing a good supply of humus, and in about three months' time the original root ends will have developed a good supply of fibres. At the time of removal these are not interfered with more than can be avoided, the necessary excavation for removing the tree from its original position and severance of any lower roots being made beyond the terminals of the young root growth. The head of a large tree should be materially shortened at the time of removal. The cutting of roots in the first instance should be performed when the tree is in a dormant state. In the case of citrus, conditions are generally favourable about March. Tropical varieties handled in this manner can be removed at almost any time after sufficient roots have formed and hardened, and may be first treated at any time of the year at the period known as " between growths ".—(*Queensland Agricultural Journal*).

Current Research

Periodic Failure of the Punjab-American Cotton Crop.—By R. Thomas, B. Sc., (*Agriculture and Live Stock in India*, Vol. 2. 1932. pp. 243-275). In some years the Punjab-American cotton crop has been afflicted with what appeared to be a mysterious "disease". The damage resulting therefrom in a year of general crop failure may exceed £5 millions. The disease was fairly general over the Punjab Province in 1919, 1921, 1926—28.

The author is of the opinion that the basic cause of these periodic crop failures in the Punjab is the cotton White Fly (*Bemisia gossypiperda*). The intensity of the White Fly in any year is believed to be controlled largely by rainfall during the months May to August, and also largely by predators and parasites.

Practical and economic methods of controlling White Fly have been applied on a commercial scale on the plantations of the British Cotton Growing Association. These methods include (*a*) Spraying the cotton crop during the months of July and August with resin-soda compound; (*b*) Manuring the crop at the flowering stage (end of August or early September) with a light dose of nitrogenous manure; (*c*) Delaying the sowing until late in May or early in June; and (*d*) Breeding strains of cotton relatively immune to the effects of White Fly attack.

Tuberculosis in a Cow-buffalo with a Review of the Disease in India.—By R. N. Naik. (*Ind. J. Vet. Sci. and Animal husbandry*, Vol 2. pp. 53—56). Tuberculosis in cattle has received a good deal of attention from medical workers in India on account of its transmissibility to human beings. Until recently, the disease was regarded by certain workers as a rare condition, but the later findings especially those of G. Taylor (1903) showed that the disease was by no means uncommon, whilst Soparkar (1925) has brought forward considerable evidence in support of Taylor's statement and his latest (1931) findings show an incidence of 22.95 per cent among cows, bullocks and buffaloes and of 23.6 per cent among buffaloes slaughtered at Lahore. Soparkar (1925) has also shown that the susceptibility of buffaloes following upon artificial inoculation worked out at 88.8 per cent in the case of *Jafarbadi* buffaloes and 87.5 per cent in the case of *Murrah* buffaloes and thus he was led to regard the buffalo as being somewhat more susceptible to tuberculosis infection than the cow. In spite of so much evidence on the incidence of

tuberculosis in cattle the great paucity of a natural clinical case of tuberculosis in buffaloes on record is really very surprising. The writer in the present communication has described a natural case of acute generalised tuberculosis in a *Jafarbadi* buffalo-cow and has treated in detail the symptoms and post-mortem lesions observed in her.—(Author's abstract).

Sugarcane Sorghum Hybrids, Pt. I—General Outline and Early Characters.—By T. S. Venkatraman and R. Thomas. *(Ind. Jour. Agri. Sci.* Vol. 2, pp. 19-27.) This is the first of a series of papers on inter-generic hybrids between sugarcane and sorghum.

The sugarcane crop in sub-trophical North India—wherein is located the bulk of the Indian area under cane—hardly gets a period of six months really favourable for growth, though it occupies the land for almost a year. Hence it was thought that canes maturing in about six months might prove useful in these regions. With this end in view the cane was crossed with certain cereals and success was obtained with sorghum. Juice analyses were given of certain of these hybrids maturing in six months, and these compare favourably with those of the canes in cultivation.

Leaf Diagnosis and the Interpretation of Fertilizer Requirements of Plants.—Murneek, A. E. and Gildhaus E. J. (*Science* 1931, 74 : 39-40 bibl. 7.) The writers criticise the findings of Lagatu and Maume, in Ann. Sci. Agron. 1930, 47. 5. 596, who enunciate the following principles as a result of ten years' work—that, when one of the major elements—nitrogen, phosphorus or potassium—is omitted from a fertilizer, the other two will be absorbed proportionately more, thus leading to unbalanced nutrition, disturbed metabolism and reduced yield. The data for these statements were obtained from the grape vine and potato by chemical analysis of leaves for N, K_2O, P_2O_5 and Cao. Working on Pyrus malus grown in pure quartz sand and supplied with the necessary nutrients the writers of this paper found on the contrary that the reduction or total omission of either nitrogen or potassium in no instance resulted in an increased potassium or nitrogen content, respectively, of leaves; in fact a decrease of nitrogen in the nutrient medium resulted in a decrease of potassium concentration in the leaves and decreased nitrogen concentration followed a decrease of potassium in the nutrient. The writers consider that the discrepancies may be partly accounted for by the fact that Lagatu and Maume used only the basal leaves of fruiting canes of Vitis, and of a tuber-bearing plant like the potato. Since in the case of tomato it has been demonstrated that every one of the three elements, nitrogen, phosphorus and potassium, is removed from the lower

leaves whenever a shortage of a particular element for vegetative extension or fruit development occurs, it is not difficult to see how the concentration of any two of the three major elements of soil nutrients may increase in the leaves, when one is in minimo for the development of other metabolically more active organs. This would be due then to unbalanced nutrition of particular organs and not to increased absorption by the plant.—(Extract from *Agriculture and Live Stock in India*).

Inter-relation between Scion and Stock in Citrus, with special Reference to the Influence of Scion on Stock.—(Japanese—English summary)—(*Tanaka, Y. Studia Citrologica*, 1931, 4: 213-27 bibl. 17.) The varieties of citrus were grafted on 3-year-old seedling trifoliate stock to the number of 708 individuals. Two years later ten plants of each, subsequently reduced to eight or less to eliminate all irregularities, were dug up, carefully examined and measured. The followiug general conclusions were formed: 1. When stock and scion are not congenial, development of top and root is poor. 2. When stock and scion are congenial, the habit of the top is strongly reflected in the growth of the root. As an example, trifoliate stock carrying sweet orange is deep rooted with the angles of the root branches narrow, but when carrying lemon it is shallow rooted, with wide angled root branches, and the colour of the roots is lighter. With all the species tested trifoliate stock always showed the characteristic swelling of the crown immediately below the union, but in a greater or less degree according to species.—(Extract from *Agriculture and Live Stock in India*).

Foot-Rot and "Black-Point" Diseases of Wheat in the Central Provinces.—By J. F. Dastur, M. Sc. Mycologist to Government, C. P. Nagpur. (*Agriculture and Live Stock in India.* Vol. II, 1932, pp. 275-282). Considerable damage is caused annually to wheat crop in this Province; the chief causes are (1) death of plants due to the infection of the basal parts by fungi causing foot-rot diseases, (2) poor tillering of infected plants, and (3) failure of a large number of flowers to set grain. Another source of loss is the development of a large number of "black-point" seeds in what look like normal ears. Foot-rot infected plants may die at all stages of growth but the highest casualty is in the seedling stage. The fungi causing the foot-rot diseases are not confined to the underground parts of the plant but they also infect the ear.

The foot-rot fungi are both parasitic and saprophytic. They are parasitic on tender parts of the plant and saprophytic on the dead parts, such as the coleoptile and lowermost foliage leaves. They are also capable of remaining

dormant for long periods, *e.g.*, in "black-point" seed and in dead diseased parts of the plant, the causal fungi have been known to be viable for three years at least.

From field observations and field experiments it seems that the fungi that cause the foot-rot diseases of wheat are generally present in our wheat soils, and given the requisite favourable conditions the plants become infected, whereas under unfavourable conditions the plants remain free from disease. The factors that influence the incidence of the disease seem to be associated with air temperature.

To ensure a crop free from foot-rot diseases wheat sowing should be delayed as long as possible after the end of rains. It appears that high atmospheric humidity, when the crop is in ear, encourages the incidence of the "black-point" disease; if there is a precipitation or if many days are cloudy and moist, a large number of grains show the "black-point" disease; but in a dry season the percentage of black-point seed is negligible.

There does not seem to be any particular variety or varieties more susceptible to foot-rot disease than others, but some varieties, like *Bansi* and Pusa 100 are distinctly more susceptible to the "black-point" disease. Bansi is particularly susceptible to infection by Helminthosporium sativum.

A Preliminary note on the Contabescence of Anthers in Cotton.— By R. Sankaran, M.A, Assistant to the Cotton Specialist, Coimbatore. (*Agriculture and Live Stock in India*, Vol. II 1932, pp. 297-308). Contabescence was the term designated by Gartner to the abortive condition of anthers and pollen in flowers. In cotton, it has been observed that a high percentage of shedding occurs among young bolls produced in the later part of the season. It is very likely that non-fertilization may be one of the serious causes inducing abscission of flowers and young bolls, and one of the factors contributing towards non-fertilization is the contabescence of anthers. It was therefore suggested that a study of the phenomenon of contabescence might throw some light on this problem. This note deals with the data obtained on the subject.

The percentage of contabescent anthers per flower is found to exhibit a periodic seasonal fluctuation. The early-formed flowers are prone to contain a much higher percentage than the later-formed ones. It is suggested that this diminution in contabescence may be due to the higher temperatures prevailing then, and the senescence of plants at the later period.

Preliminary Report on the Vitamin content of the Mango.—By E. O. V. Perry and S. S. Silva. (*Bulletin of the Empire Marketing Board*).

1. The pulp of three varieties of Indian mango *Alphonso*, *Cawasji Patel* and *Shendrya* was examined for its content of vitamins A, C and D. The *Alphonso* variety was tested for vitamins A and C in 1930 and for vitamins A, C and D in 1931. The other two varieties were tested for the three vitamins in 1931 only.

2. The results show that the pulp of the "Alphonso" variety is one of the most potent sources of vitamin C. The *Cawasji Patel* variety is slightly less active but is as potent as the previously best known natural antiscorbutic source. The *Shendrya* variety contains in comparison little vitamin C.

3. One test carried out on the rind of the *Alphonso* variety showed that it contained at least as much vitamin C as the pulp.

4. The pulp of all three varieties contains vitamin A in quantities similar to that possessed by butter. The "Alphonso" variety is somewhat better than the other two varieties in this respect.

5. No very significant amount of vitamin D was found in the pulp of any of the three varieties.

Crop Forecasts

COTTON

First Cotton Forecast, 1932-33.—All India.—This forecast is based upon reports on the condition of the cotton crop at the end of July or early August. The reports do not, as will be seen from the detailed notes from below, relate to the entire cotton area of India but to only 77 per cent of the total.

The area sown is at present estimated at 13,485,000 acres, as compared with 13,938,000 acres (revised) at the corresponding time last year, or a decrease of 3 per cent.

Weather conditions at sowing time were not quite favourable, and the present condition of the crop is, on the whole, reported to be fair.

Central Provinces and Berar (19.4 per cent).—The area sown is estimated at 4,494,000 acres (3,011,000 acres being in Berar), which is 4 per cent below the corresponding area of last year. The decrease is attributed to the low price of cotton and the failure of the crop last year.

Cotton in Foreign Countries.—From information specially obtained from the United States Department of Agriculture, Washington, it appears that the area of cotton in cultivation on 1st July 1932, in the United States of America is estimated at 37,290,000 acres, showing a decrease of 9 per cent as compared with the corresponding estimate (revised) of 1931. The production of the crop for the current year is at present estimated at 11,306,000 bales of 500 lbs. each (equivalent to 14,132,000 bales of 400 lbs. each), as compared with 17,096,000 bales of 500 lbs. each (equivalent to 21,370,000 bales of 400 lbs. each), the revised final estimate of 1931.

From the latest available bulletin published by the International Institute of Agriculture, Rome, it appears that in Egypt the area planted to cotton this year is estimated at 1,135,000 acres, which is 35 per cent less than that of last year. The production of the cotton crop of Anglo-Egyptian Sudan for 1932-33 is estimated at 246,300 bales of 400 lbs each, as compared with 119,000 bales in the preceding year.

SUGARCANE

First Sugarcane Forecast, 1932-33—This forecast is based on reports received from provinces and States which contain, on an average, 95 per cent of the total area under sugarcane in India.

The total area planted with sugarcane this year is estimatod at 2,982,000 acres, as against 2,750,000 acres (revised) at this time last year, or an increase of 8 per cent.

Central Provinces and Berar (o.8 per cent).—The area is estimated at 24,000 acres, against 21,000 acres, the corresponding area of last year. Weather conditions at planting time were favourable.

Sugarcane in Foreign Countries.—From the latest information received from the Sugar Technologist to the Imperial Council of Agricultural Research India, Cawnpore, it appears that the world's production of sugar, both cane and beet, in 1931-32 is estimated by Messrs. Willet and Gray at 26,200,000 tons, showing a decrease of 2,565,000 tons, as compared with the preceding year. As compared with 1930—31, there has been a decrease of 2,766,000 tons in the production of beet sugar, but an increase of 201,000 tons in that of cane sugar.

GROUNDNUT

First Groundnut Forecast, 1932-33.—The forecast is based on reports received from the three provinces of Madras, Bombay and Burma which to-

gether contain a little over 83 per cent of the total area under groundnut in India. The report does not, as will be seen from the detailed notes below, include information regarding the main crop of Madras, but relates only to the summer and the early varieties grown in that province.

The total area, so far reported, is estimated at 1,681,000 acres, as against 1,510,000 acres reported at the corresponding time of last year, or an increase of 11 per cent.

OBITUARY

We have to intimate with deep sorrow the death of one of our first-year students, **Mr. A. K. Bhaumik.** He was with us only for a short time having been called to his home in Calcutta early in August. There he developed an illness which in the end proved fatal. He showed great keenness in his work and was popular. We offer our heart-felt condolences to his parents in their bereavement.

May his soul rest in peace!

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Editorial

THE OTTAWA AGREEMENT IN RELATION TO INDIAN AGRICULTURE

The passing of the tarriff bill by the Indian legislature to give effect to the trade agreement with Great Britain, commonly known as the Ottawa Agreement, is likely to have an important bearing on the future economic development of India. The trend of trade in the United Kingdom in recent times made such an agreement imperative. Great Britain, the champion of free trade in the 19th Century, has been slowly moving towards protection since the great war. At the beginning of 1932 she adopted protection as a definite trade policy by passing the Import Duties Act and informed the empire units that import duties would be levied on their goods imported into Great Britain unless they were prepared to enter into an agreement of reciprocal preferance with Great Britain. Accordingly the Government of India received a notice from the Government of the United Kingdom that certain articles, on which they have decided to levy import duties, would be free from duties till November 1932 after which date the duties would become operative unless the Government of India entered into an agreement with the United Kingdom giving preference to certain British goods in India. This precipitated a situation in which the Government of India was forced to revise its previous policy regarding Imperial Preference. The question was no longer what India stood to gain by entering into a scheme of Imperial Preference but what she stood to lose by remaining out of it. India is mainly an

exporter of raw materials, consisting mostly of agricultural produce. She also exports a certain amount of semi-manufactured goods such as vegetable oils, tanned hides, pig iron etc. which is bound to be on the increase with the growing industrialisation of the country. On both these kinds of commodities Indian produce has to encounter serious competition from other countries and the situation would be disastrous if India stood out when other parts of the empire entered into a scheme of reciprocal preference with Great Britain. The United Kingdom is still the largest single purchaser of Indian produce and she can ill-afford to lose her vast trade with that country. It was in these circumstances that the Government of India decided to send a delegation to the Imperial Economic Conference arranged to take place at Ottawa. The decision of the Indian Delegation to enter into an agreement of reciprocal preference with the United Kingdom was taken with due regard to the present position and the future requirements of Indian industries and the policy of Discriminating Protection which she has lately adopted to safeguard her industries. According to the agreement India shall give a preference of 10 per cent on 58 commodities of British origin mostly manufactured and in return the United Kingdom has agreed to give a similar preference on 30 Indian products among which are included some of our primary agricultural products like wheat, raw cotton, oil-seeds and vegetable oils and tea.

The agreement was subjected to very severe criticism from all over India. When the matter came before the legislature a committee of specialists was appointed to scrutinise the whole agreement. After sitting for over two weeks the committee by an overwhelming majority reported in favour of giving a trial to the scheme for a period of three years. The agreement was then passed by a large majority.

All trade agreements are based on probabilities and this agreement is also based on the belief that it will bring about an expansion of the trade of India with Great-Britain and *vice versa*

to the mutual benefit of the two countries concerned. Mr. Shanmugam Chetty, a member of the Indian Delegation to Ottawa, is reported to have said in the course of a speech in Madras that the Indian cultivators stood the chance of being completely wiped out of the British market if India adopted a *non-possumus* attitude. This would certainly be a great calamity in view of the fact that Great Britain is still our largest single customer for most raw materials. It is often said that India need have no fears concerning her export trade in raw materials because most of them are of a monopoly type, and the instance of jute is often cited. But as the report of the Indian Delegation points out "the number of such commodities is very small and even where India is by far the largest supplier of a particular commodity—the United Kingdom for example takes more than 99 per cent of her imports of myrobolams from India—the trade in these commodities is exposed to the competition of other articles natural or synthetic which will serve the same purpose as India's natural products. Thus for example, the tanner uses many other tanning materials besides myrobolams; or again, to take another example, India has no dangerous rival as an exporter of lac but the competition between natural lac and synthetic substitutes is of the keenest and most formidable kind. Apart from the small class of commodities indicated above, India's exports of agricultural and other raw products are in competition with similar articles produced in many other countries. India has no monopoly and if she is to retain the trade she has already built up and to extend her trade in new directions in accordance with variations in world demand she must see to it that out-lets for her produce which have hitherto been open are not closed against her." This grave danger of losing our biggest market is apprehended in the case of a number of commodities like tea, oil seeds, vegetable oils, spices, wheat, etc. The case of oil seeds is of special interest in this province which is an important producer, particularly of linseed. At the beginning of the present century India occupied the first place in the production of linseed contributing nearly 90 per cent

of the world's exports. But of late years India has been steadily losing ground to the Argentine and her share has dropped to about 10 per cent while the Argentine's share has risen to over 50 per cent. The United Kingdom imports large quantities of linseed every year. In the quinquennium ending 1926—30 her average imports amounted to 3,14,000 tons a year, of which about one sixth was supplied by India and the rest by the Argentine. In the same period India exported on an average 2,15,000 tons a year of which only one quarter went to the United Kingdom. There is thus plenty of scope for the expansion of India's trade in this commodity with the United Kingdom. The latter is even now India's largest customer and her requirements are more than the whole of India's exportable surplus. English manufacturers prefer Indian linseed to that of any other origin because of its high quality oil and high oil content. Nevertheless the Argentine has been able to dislodge India from the English market. It is purely a matter of prices. The Argentine is able to execute orders for much larger quantities and at slightly cheaper prices. In these circumstances a ten per cent preference, according to the Ottawa Agreement, in favour of Indian linseed over the Argentine, must surely be a potent factor in helping India to recapture the market she has lost in the United Kingdom. The area under linseed in India has of late shrunk considerably owing to a waning demand. If a market is assured India can recover the ground she has lost. The Indian Delegation anticipates an expansion of the area under linseed in India by at least two million acres as a result of the increased demand arising from the ten per cent preference to Indian linseed. This development is a matter of special importance to the Central Provinces which is the most important linseed growing province contributing nearly 45 per cent of the area under linseed in India. The area under this crop in the Central Provinces has of late fallen considerably. In the quinquennium ending 1908-09 it was nearly double the present area. It may be hoped that with the general expansion of the area under linseed in India the

Central Provinces may soon go back to the old level of production.

The case of linseed discussed above is typical of most other agricultural products exported to foreign markets. Vegetable-oils, wheat, tea, cotton, lac, all these stand to gain considerably by the preference offered by the United Kingdom and it is hoped that the agreement will usher in an era of increased production and rising prices for which the tiller of the soil has looked in vain for a long time.

Original Articles

EFFECT OF VARYING MOISTURE CONDITIONS ON THE GROWTH OF RICE IN TYPICAL LIGHT, MEDIUM AND HEAVY SOILS, OF THE CENTRAL PROVINCES*

BY D. V. BAL

AND

R. N. MISRA

Department of Agriculture, Central Provinces.

During the course of experiments conducted by the writers to study some of the aspects of rice cultivation in heavy soils of the Central Provinces, an account of which has recently been published (1932), it was observed that the rice crop showed a better growth in heavy soil not submerged under water, than that obtained when the soil was kept submerged under water to a depth of about 2″ to 3″ according to the usual practice followed in the rice tracts of the Province. This observation suggested that the usual practice of submerging light rice soils under water if applied to heavy soils was not only harmful from the point of yield of paddy but that it also involved a considerable waste of irrigation water which could be utilised in extending the cultivation of rice to other suitable areas. In view of the fact that the construction of large irrigation works is limited by the natural water resources and the financial position of a country, it is essential that the available supplies of water should be economically and efficiently utilised. It was therefore considered

* Paper read before the Agricultural Section of the Indian Science Congress held at Patna, in January 1933.

desirable to study the effect of varying moisture conditions on the growth of the rice crop in different types of soil possessing varying water holding capacities, and this paper records the results of pot culture experiments conducted to study this problem.

Experimental.—Pot culture experiments on the growth of rice in three typical soils representing the light, medium and heavy rice soils of the Province were carried out during the years 1929, 1930 and 1931. The light, medium and heavy soils employed in the experiments described in this paper are locally known as *Matasi*, *Dorsa* and *Kanhar* respectively. The mechanical composition and the water-holding capacity of the different soils are given in table I.

Two types of water treatment as indicated below were adopted in these experiments;—

(*a*) The soil from one series of the manured and the unmanured pots was kept constantly submerged under water, the height of the latter being maintained at about 2″ above the surface of the soils. The holes at the bottom of the pots were kept plugged in order to avoid drainage and to maintain a constant level of water in the pots. Under the field conditions however a certain amount of drainage occurs and depending upon the availability of water supply the rice fields are filled with fresh water 3 or 4 times in the season. In order to imitate the field conditions as far as possible in our pot culture experiments the holes at the bottom of the pots were occassionally opened and the stagnant water was allowed to drain away. After the drainage was completed the holes were replugged and fresh water was added to the pots to the required extent. During the period of growth of the rice plants this operation was usually carried out three times. When the grain was nearly ripe according to the local practice the water from the pots was drained off, and the crop was allowed to attain complete maturity without any further addition of water to the soil.

(*b*) The soil from the other series of the manured and the unmanured pots was not kept submerged under water. For this purpose the holes at the bottom of the pots were not plugged as described under (*a*) above. Water was added to the pots from time to time soon after the soil gave an indication of cracking on the surface. This was continued till the grain was nearly ripe after which watering was stopped as mentioned under treatment (*a*) above.

Showing the growth of rice plants in duplicate pots containing heavy (*Kanhar*) soil. Left, submerged under water and right, water drained.

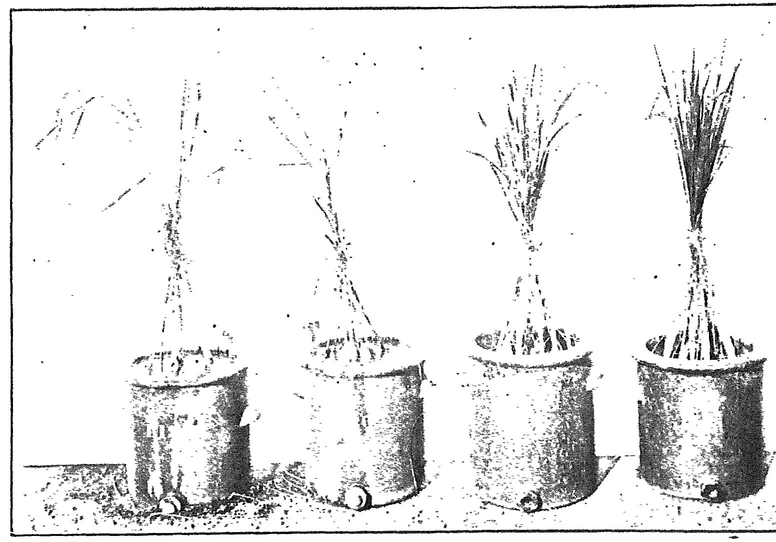
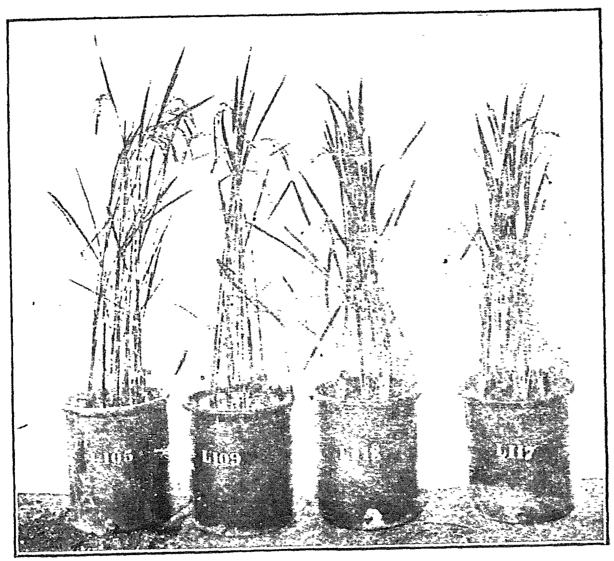


FIG. 2. Showing the growth of rice plants in duplicate pots containing medium (*Dorsa*) soil. Left, submerged under water and right, water drained.



Showing the growth of rice plants in duplicate pots containing light (*Matasi*) soil. Left, submerged under water and right, water drained.

At the time of transplanting the rice seedlings green manure (*sannhemp*) at the rate of 4,000 lbs per acre, was incorporated in the soil of the pots belonging to the manurial series. Quadruplicate pots were employed for each kind of treatment, and all the pots under experiment were protected from the rain by a glass roof. The yield of straw and grain as well as the weight of the total crop obtained per pot of the unmanured series are given in table II and those obtained from the pots belonging to the manurial series are given in table III.

Discussion of results—Unmanured series :—

Matasi soil.—It will be seen from the results that in the case of the light (*Matasi*) soil the growth of rice was somewhat better, when the soil was kept submerged under water than when it was kept drained. This indicates that under field conditions it would be an advantage in the case of the light soils, to impound rain water in rice *bandhis*, particularly where irrigation is not available and where water cannot therefore be applied to the soil when required.

Dorsa soil.—In the case of the medium (*Dorsa*) soil, pots which were kept constantly drained gave a better yield of paddy than those in which the soil was kept submerged under water.

Kanhar soil.—In the case of the heavy (*Kanhar*) soil it is seen that when the soil is kept submerged under water the growth of rice plants is very poor. If however the soil is not kept submerged under water, but is allowed to drain freely and supplied with adequate quantities of water only when required the growth of the crop is almost normal and the yields are considerably improved. The results also indicate that a heavy soil not kept submerged under water gives almost as high yields as are normally obtained frem a light *matasi* soil kept submerged under water.

Comparative growth of the rice crop in pots containing the various, soils and receiving different water treatments can be seen from figures I, II and III.

Manurial series :—

The figures of yields of pots from the manurial series given in table III show that the results obtained are of the same order as those obtained from the series not receiving any manure, but as a result of application of green manure to the soil, the yields from the former are higher than those obtained from the latter.

From the results discussed above it is clear that although paddy in the case of light soil is to a certain extent benefited if the soil is kept submerged under water, yet such a practice does not appear to be quite essential provided the soil can be watered from time to time when required. In heavy

soils however the paddy crop suffers considerably due to the submergence of the soil under water, and in order to obtain normal crops it appears necessary to give water to such soils only when required.

The results of the three years' experiments recorded in tables II and III, corroborate each other very closely, in spite of the fact that the yield in the year 1931 was about ½ that in the years 1929 and 1930.

Summary.—(1) An account of pot culture experiments on the growth of rice in light, medium and heavy soils, from the rice tract of the Central Provinces has been given.

(2) These experiments clearly indicate that if heavy rice soils, are kept submerged under water, the growth of rice is adversely affected and the yields are considerably decreased. If on the other hand water is applied to such heavy soils, only when required, a normal yield of paddy is obtained.

(3) The behaviour of rice in medium soils is of the same type as described in the case of the heavy soils, but it is not of the same order.

(4) Both the types of water treatments seem however to suit quite well to the paddy crop in the case of the light soils.

References.—Bal, D. V., and Misra, R. N. (1932) *Agri. Live-Stock. India.*, 2,404—416.

Table I, Showing the mechanical composition and maximum water holding capacity of the soils.

Soils.	Percentages on air-dry soil passed through 1 m. m. sieve.							
	Coarse sand.	Fine sand.	Silt.	Fine silt.	Clay.	Moisture.	Ca CO_3	Maximum water holding tcapaciy.
Matasi I (Light Soil.)	1.94	8.50	40.08	27.30	18.40	0.84	0.24	30.10
Dorsa I (Medium Soil.)	1.33	8.33	23.59	18.72	39.98	1.92	0.59	43.20
Kanhar I (Heavy Soil.)	0.60	4.04	12.66	19.97	53.00	2.44	3.22	54.30

Table II, Showing the yields of paddy in grams per pot from the unmanured series. Number of plants per pot = 8 (Variety Bhondu.)

SOIL.	1929								1930								1931							
	Soil kept submerged under water.				Soil not kept submerged but water added as required.				Soil kept submerged under water.				Soil not kept submerged but water added as required.				Soil kept submerged under water.				Soil not kept submerged but water added as required.			
	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.
Matasi (Light soil) ...	52.0	37.6	89.6	78.9	36.7	20.5	57.2	58.2	34.1	31.2	65.3	70.9	28.7	28.9	57.6	70.6	21.7	25.5	47.2	43.1	17.8	20.2	38.0	38.8
	42.8	31.0	73.8		36.8	20.3	57.1		32.2	34.3	66.5		35.0	35.0	70.0		24.5	23.5	48.0		14.3	25.0	39.3	
	41.3	31.6	72.9		30.4	23.1	53.5		36.6	35.9	72.5		32.2	36.6	68.8		17.7	20.3	38.0		17.7	20.2	37.9	
	45.5	33.7	79.2		37.4	27.3	64.9		39.4	38.8	78.4		39.1	46.8	85.9		18.8	20.5	39.3		15.0	25.0	40.0	
Dorsa (Medium soil) ...	25.0	18.1	43.1	46.4	41.7	30.5	72.2	73.1	35.9	27.7	63.6	54.2	34.0	29.5	63.5	65.9	19.0	18.2	37.2	34.2	26.5	25.7	42.2	39.1
	26.5	19.1	45.6		35.8	29.7	65.5		34.7	27.5	62.2		34.5	29.2	63.7		20.8	21.5	42.3		21.4	18.4	39.8	
	25.3	21.0	46.3		44.4	30.5	74.9		23.6	19.0	42.6		23.6	19.0	65.7		12.8	14.0	26.8		17.8	19.5	37.3	
	28.9	21.6	50.5		45.4	34.5	79.9		26.9	20.8	47.7		37.5	33.1	70.6		12.6	18.0	30.6		19.5	17.8	37.3	
Kanhar (Heavy soil) ...	...	...	...	...	...	...	...	...	12.6	13.0	25.6	27.1	41.6	42.5	84.1	77.0	3.9	4.6	8.5	5.0	17.1	19.4	36.5	34.3
	...	...	...	...	...	...	...	...	19.3	15.5	34.8		35.6	35.3	70.9		2.3	2.8	5.1		13.0	16.0	29.0	
	...	...	...	...	...	...	...	...	7.5	7.2	14.7		36.6	35.8	71.8		0.2	1.0	1.2		15.0	18.1	33.1	
	...	...	...	...	...	...	...	...	18.0	15-2	33.2		40.8	40.2	81.0		2.3	2.9	5.2		19.0	19.6	38.6	

Table III, Showing the yields of paddy in grams per pot from the green-manured series. Number of plants per pot = 8 (Variety Bhondu).

SOIL.	1929								1930								1931							
	Soil kept submerged under water.				Soil not kept submerged but water added as required.				Soil kept submerged under water.				Soil not kept submerged but water added as required.				Soil kept submerged under water.				Soil not kept submerged but water added as required			
	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.	Grain.	Straw.	Total crop.	Average of total crop.
Matasi (Light soil) ...	46.5	33.7	80.2	85.8	38.5	26.1	64.6	64.4	69.0	58.2	127.2	108.2	52.5	50.0	102.5	98.8	25.6	32.4	58.0	50.5	21.0	30.0	51.0	47.5
	40.4	37.9	78.3		37.5	25.7	63.2		52.0	43.7	95.7		50.7	54.0	104.7		29.2	20.8	50.0		20.2	28.0	48.2	
	49.7	37.4	87.1		40.0	27.0	67.0		62.6	55.4	118.0		43.5	40.2	83.7		19.1	27.0	46.1		18.0	26.2	44.2	
	52.4	45.2	97.6		38.0	24.9	62.9		50.5	41.2	91.7		55.0	49.3	104.3		20.0	27.7	47.7		18.4	28.1	46.4	
Dorsa (Medium soil) ...	44.1	29.2	73.3	74.9	48.8	29.0	77.8	83.2	31.8	23.2	55.0	64.6	37.8	42.1	79.9	79.2	24.5	28.5	53.0	47.9	22.7	33.2	55.9	53.4
	53.0	34.0	87.0		44.6	39.5	84.1		46.4	37.4	83.8		46.3	36.6	82.9		26.7	24.3	51.0		26.5	23.5	50.0	
	41.0	26.8	67.8		50.6	35.8	86.4		25.0	28.8	53.8		38.1	36.8	74.9		22.7	18.1	40.8		28.0	26.6	54.6	
	42.2	29.3	71.5		45.0	39.3	84.3		37.1	28.7	65.8		35.9	43.3	79.2		17.0	29.8	46.8		27.7	25.4	53.1	
Kanhar (Heavy soil) ...	...	...	...	...	...	...	...	...	15.0	13.1	28.1	27.9	41.8	42.4	84.2	95.7	6.7	2.1	8.8	9.9	24.5	25.9	50.4	39.9
	...	...	...	...	...	...	...	...	14.8	12.6	27.4		56.4	41.6	98.0		3.0	3.3	6.3		15.0	16.9	31.9	
	...	...	...	...	...	...	...	...	17.8	18.2	26.0		43.1	53.4	96.5		6.5	4.5	11.0		15.7	17.8	33.5	
	...	...	...	...	...	...	...	...	18.6	11.5	30.1		53.7	50.3	104.0		6.4	6.9	13.3		20.5	23.1	43.6	

RURAL LIFE IN DENMARK

By P. Oomman Philip, B.A.

The real test of the prosperity of a country is the condition of its peasantry, its ordinary people. What does it profit any country if it has a few maharajas, nawabs and zemindars able to make extravagant displays of their wealth when the large majority of the population are in abject poverty and chronic indebtedness not having even one meal a day? This is, alas, the condition of India today, and never before did this oppressive truth come home so poignantly to me as when I spent some days recently in Denmark. By the very contrast of the condition of the peasantry of that land I was at every turn sadly reminded of the miserable level of existence to which our people had sunk. To be told that the cause of the degradingly low life of Indian farmers is for the most part in themselves, in their outlook on life which somehow is impotent to save them from themselves, from their lower natures and tendencies, is no consolation. Those who love the country cannot rest satisfied till they ascertain whether this is so and set in motion forces which will energise our people and transform them from within. It is a matter for thankfulness that in these days there are many who are eager for such service, and to all such a study of the forces that made the Danish peasantry what they are to day will be of inestimable value.

Not long ago the Danish peasantry was also not in a very different condition from that of the Indian farmers. We find them at the beginning of the nineteenth century in a depressed condition, spending their lives in dependence on estate owners and government officials in a mood of sullen resignation. They were without culture and technical skill, seldom able to rise above the level of bare existence. All this is now changed. How did this transformation take place?

One of the most potent causes was the introduction of land reform legislation which, in turn, was one of the direct results of the free constitution established for the country in 1849. Under this legislation the old system of communal tillage was discarded; the farmer who formerly was a tenant of the manor, became a free-holder; villeinage was abolished and the personal dependence of the peasant on the squire ceased. These reforms were of vital importance to the social development of Denmark, in that they enabled the country to escape the danger of getting a numerous and powerful class of landed proprietors on the one side and a poor country proletariat on the other. In this way the distribution of Danish soil such as obtains today was

determined. In the year 1800 the number of freeholdings totalled about 91,000; but in 1916 the figure was something like 184,000. This means that over 90 per cent of the total holdings in Denmark are free holdings and the average holding of a Danish farmer is about 25 acres. State legislation affords protection to the small farmer against competition from the owner of large holdings and also prevents indiscriminate division into small holdings.

The practical abolition of class divisions among the Danish farmers has been another factor contributing to their progress and prosperity. On the average medium-sized farms called *gaardene*, the owner (called *gaardmand*, or farm-man) joins with his helpers in the work of the field and stables. His fellow-workers are either his own sons and daughters or the children of other farmers who have smaller holdings (called *husmand*, or home-men). These assistants work with the conviction that in due course they also will become independent land holders. It is on these farms that the rising generation of farmers get their practical experience. The young people board and lodge on the farms and this, in most cases, means that the employer's home is also their home where they eat, work and spend their leisure with the family. Under such a system there is no room for caste feeling or class struggle. The sense of fellowship and the recognition of common interests are the strongest bonds that unite Danish farmers. *Gaardmand* and *husmand* come from the same stock, the children and grand children of the *gaardmand* constituting a large proportion of the *husmand*. What a long long way we have to travel in India before we can hope our farm-labourers or their children to be admitted into the homes of our land-owners on terms of social equality!

Along with the democratic distribution of property and the practical elimination of the distinctions between the rich and the poor that Denmark has achieved in the life of her country population, there is another factor that has made valuable contribution to the making of the modern Danish peasantry. It is the spiritual movement among Danish peasants that created a fellowship among them in the quest of the joys and values of human life. The name of Grundtvig is prominent in this connection as the prophet and inspirer of this movement for larger life. A poet of distinction and a man of rich spiritual experience, he was at the same time full of intense love for the rural population of Denmark. When in 1814 at the end of the wars in which Denmark was involved peace was signed and Denmark became separated from Norway with which country she had been united for 400 years the little impoverished country sank into a torpor which resembled the tranquillity of death. It was at this time that Grundtvig with his robust faith in God and with a great love

for his own suffering people gave the leadership that they desperately needed. His whole work for the enlightenment of the common people was based on his strong Christian faith in the inherent nobility of mankind. He recognised and practised the closest kinship with his fellows however poor and ignorant. In a song he wrote :—

"And be we poor and lowly;
Yet are we sons of kings
And higher than the eagle
Hope may spread out her wings".

He did not approach his countrymen as one who would condescend to give them crumbs from the tables of science, art and culture. He wished to share everything with the people, to live in common with them and to nourish himself from the same sources that were accessible to the lowliest. Grundtvig's view of life placed him in opposition to all other prominent men in Denmark of the time who believed in spreading knowledge and culture only through small select groups. He addressed himself to the whole of his countrymen. He decided not to use his poetical gifts only for the edification of those with aesthetic tastes, but with his poetry he would sing a higher life into the Danish people. His dreams were not however easily realised. The cultured people considered him as a visionary and left him severely alone whilst the common people still slumbered too deeply to be able to hear the loving voice which called them to a more spacious and fuller life. For a long time he pondered over the problem of how to awaken his people and the idea dawned upon him that what was necessary was a free school for adults where in their native language they could learn of reminiscences of the life of their forefathers and thus be awakened to continue that life as a people. This was the beginning of the folkhigh school movement of Denmark, which has done so much for the upbuilding of modern Denmark. Towards the middle of the nineteenth century these schools came into existence not with the support of the state at first but as the result of the voluntary work and sacrifice of the people themselves who were inspired by the ideals of Grundtvig. In later years the state came in and rendered help to these folk high schools.

The spiritual and moral qualities so necessary for the building up of that worthy rural civilisation we now find in Denmark have been fostered and developed generation after generation among the young people of her farms through these folkhigh schools. By the study of their own past history and of their music and art; by acquaintence with the history of other countries; by the study of modern languages and by availing themselves of religious and spiritual ministrations offered for strengthening their inner life and for helping

them to be unselfish and willing "to bear one another's burdens", the pupils who attend the folkhigh schools are educated for citizenship as no university perhaps can. Careful students of Danish life observe that the remarkable success attained by the co-operative movement among the Danish farmers has been almost wholly due to the silent but solid work of character-building which the folkhigh schools have been accomplishing among successive generations of young people.

It was my privilege to visit some of these folk-high schools in Denmark last July. During summer, girls of between 16 and 30 who have finished their general education and belong to farm houses come to these high schools and are in residence for two or three months, each girl paying as much as about Rs. 70 per month for board and lodging and tuition fees. There is a competent staff of teachers who give them instruction in various subjects such as music, history, health, modern languages, mathematics and so forth. During winter, boys from farm houses come for a similar course. When it is mentioned that these schools do not conduct any examinations or issue any certificates it will be realised that the pupils come primarily for having their knowledge increased and minds widened and souls strengthened for the work that awaits them in their farms. The state though giving grants to these schools on a liberal scale, does not think it necessary to exercise any rigid control over them as is done in other countries. A large measure of freedom is given to those who run these schools to change the subjects taught and methods employed according to the varying needs of the situation.

The real interest of the state in promoting the welfare of the small farmer; the remarkable influence of the folkhigh schools in the development of all those qualities among the common people that make for improved farming, scientific methods of cattle raising, poultry keeping and other subsidiary industries through the smooth and successful working of co-operative methods—all these are reflected in the homes of the ordinary Danish peasant. I had the opportunity of visiting some of these homes. While the members of such homes worked with their hands, and worked hard, they were able to maintain a level of culture and refinement and a standard of life which only the rich in India can hope to attain to. In almost every farm house there is the radio which enables the family to listen every day to good music and enlightening discourses. I also found in these homes decent collections of books and also scientific magazines dealing with agriculture, dairying, co-operation, banking and allied subjects. They were fairly well-informed about world movements and took genuine interest in, and supported with funds, movements

like the foreign missionary work of the Church. Their love of music and dance and amusements adds to the beauty and joy of their rural life.

Those who are concerned with the sad condition of our Indian villages and who are in various ways trying to improve them cannot do better than make a careful study of the development of rural life in Denmark. The handicaps and disabilities we have to contend against are many and serious. But the history of Denmark shews that there was a time in that country also—not long ago—when everything was gloomy and it looked as if that little country would be completely submerged by forces from outside which the people thought were beyond their power to meet or overcome. But through the awakening of the spiritual capactities lying dormant in them they were able to bring within the reach of their rural masses the comforts and conveniences which it is but their human birthright to have. The problem of rural uplift in India also is ultimately a spiritual problem, as our wisest and best men are now realising.

LAND DRAINAGE

By K. S. S. Iyer, B.E.

(Continued from our last issue)

Surface drainage—(Some methods in common use)

1. Field protection.—Many fields are often required to deal not only with the rain water falling over them but also with much larger amounts from areas in their catchment. This heavy onrush of water causes erosion and washing away of fine silt. To prevent water-logging in such areas, bunds are constructed at intervals across the slope, proper arrangements being made to drain away quickly the water collected behind them.

2. Ridge and furrow system.—In some cases it is found convenient to shape the surface of the field in the form of ridges and furrows by continuously following the 'gathering' method of ploughing. The spacing of the ridges and furrows depends on the texture of the soil, a spacing of 30 feet being found satisfactory in the case of clay loam. The field is divided along the length of slope of the land and, if very steep, at an angle to it, the gradient of the furrows not exceeding 1 in 300. These furrows lead the drainage water into a main drain and at the junction, pegs interwoven with cotton or sann stalks are fixed to prevent soil erosion.

3. Contour open drains.—In the case of some fields where owing to the

nature of the subsoil (*chopan* or stiff yellow clay) underdrainage becomes expensive, this method becomes economical and fairly effective. Open ditches approximately following contour lines are made. A contour survey of the field is made and lines of the proposed ditches are marked on the map. Then the lines are pegged out on the field and wherever possible they are straightened. Then drains about 2 feet deep and 1¼ feet wide at bottom with side slopes are dug. Along the upper margin of each ditch and 1 foot from the edge a small bund of boulders 6 to 8 inches high with a little earth covering is constructed. The water flowing over the space between 2 sets of drains is drained through the soil below the bunds into the drain having a fall not more than 1 in 400 and then to the main drain. If the land surface is fairly level this method of drainage leads to the loss of a large area of land, since the drains can be effective only if they are very close. The drains require constant cleaning to be effective. However in stiff clayey soils this system is found cheaper and as effective as underdrains. The initial cost is only about Rs. 30 per acre.

4. Pusa system.—The area to be drained is divided into convenient blocks of 5 to 10 acre plots generally rectangular surrounded by trenches the borders and sides of which are turfed to prevent cutting. The blocks and the trenches are so laid out that the latter can conveniently drain away the water into bigger channels and then to *nalas*. In this method each block deals with the water falling over it and prevents water-logging. The fields, by gradual silting, become level and washing away of silt is prevented.

The first three systems have been tried on the College Farm, Nagpur and have proved fairly effective.

Under-drainage or subsoil drainage.—In places like the heavy black cotton soil areas subjected to water-logging, surface drainage is found insufficient and subsoil drainage, though more costly than surface drainage, has to be resorted to.

The several methods in common use at present are (1) boulder drains, (2) mole drains and (3) tile drains.

Boulder drains.—These are suited and found economical in draining areas with deep rooted plants like fruit trees etc. Trenches 4 to 6 feet in depth and 1 to 1½ feet wide at bottom with side slopes are dug and filled to a depth of 1 to 2 feet with boulders of varying sizes, over which 2 to 3 inches of sand and then ordinary soil dug from the trenches are filled in. The depth of the trench varies with the slope of the land. The drains are connected and lead through a main into a *nala*.

This kind of drainage has been tried with success in the orange garden attached to the Nagpur Agricultural College. The drains were 54 feet apart,

5½ feet deep at top and 3½ feet at the end. The thickness of boulder layer was 1 to 1½ feet.

A length of 450 feet of this drain cost about Rs. 300. This amount can be appreciably reduced in places where boulders and labour are cheap. Instead of boulders, brick bats, broken tiles etc. could also be used with economy.

Mole drains.—This type of drainage is economical in places with heavy subsoil, free from stones and plant roots, the land uniformly sloping with little or no unevenness and where tractor power is available. These drains are as effective as tile drains but are less permanent. A steel cartridge 2½ to 3″ in diameter fixed to a mole drain plough is lowered into the ground to the necessary depth. This forms a sort of a circular tunnel, the soil round which is compacted and becomes hard. The mole drain plough has the necessary mechanism for adjusting the grade and the depth.

Tile drains.—The pipes used on the College Farm are almost cylindrical in shape, prepared on the potter's wheel from well prepared clay and burnt in ordinary clamps like bricks. In foreign countries cement tiles are coming into use. The smaller diameter end of one pipe fits into the larger end of the one below and 3 pipes so fitted occupy a length of 2 feet. If the potter tries to make the pipes longer they become more conical and the overlap increases. The drainage efficiency of pipes is not much affected by difference in porosity of the walls since water enters mostly through the joints.

Well burnt pipes free from even minute cracks and giving a clear ringing sound when struck are selected for use. It must be borne in mind that a single broken pipe or a badly burnt one in the system is enough to spoil its satisfactory working and would very soon render the system unserviceable.

Location of drains.—Any system of drainage should be carefully schemed out with possibilities of future development and extension as funds and necessity permit. In locating drains, the following points should as far as possible be attended to:—

(*a*) the mains should be laid along the lines of natural drainage, the laterals or minors along the lines of greatest slope ;

(*b*) the laterals or minors should be long, straight, parallel to each other and so laid out as to bring all the wet areas under their influence.

In the case of fields having a general slope it is easy to mark out the drain lines in the field directly. The main is laid out as straight as possible occupying the lowest portion of the area to be drained so that it may be placed with the least amount of digging, the minors joining it from the sides.

If the ground is almost level or if it is not possible to mark out the lines directly in the field a contour map of the area to be drained is first prepared. After deciding upon the position of the outlet proposed lines of drains are marked out on the map and then pegged out in the field.

Tile drainage systems.—Several factors have to be considered in deciding upon the system to be adopted. If the area to be drained is not very wide and the soil light a single drain line may be enough; but if the soil is impervious more than one line may be required. If a single line is not found enough, a system of drainage, depending on the nature of the surface and the shape of the area is to be adopted. The line receiving water from all other parts of the system is called the Main and all the lines receiving water directly from the soil and conveying it to a main are called Laterals or Minors. If there should be more than one system of laterals, each system flowing into a line other than the main which in turn carries the water to the main, each of these is known as a Sub-Main.

Outlet.—In any drainage scheme it is of the utmost importance that there should be a convenient outlet at which the main drain can discharge its water, as otherwise as is commonly said a drainage system without an adequate outlet is like a man "all dressed up with no place to go". The efficiency of a drainage system and the cost of installing it depends much on the position and construction of the outlet. Generally the outlet discharges itself into a natural waterway such as a *nala*, stream, river etc. It should be so situated that the ordinary outside water level is always fairly below the level of the bottom of the outlet pipe. Otherwise the outlet sometimes gets submerged, thus preventing the drains from working satisfactorily and in course of time choking them by clogging. The problem of finding a suitable outlet is a serious one and drainage schemes have often to be abandoned due to the absence of convenient outlets. The fragmented and scattered nature of the holdings in India is a serious handicap as outlets have to be taken through others fields. In such cases co-operation amongst the neighbouring cultivators or State interference is necessary.

(To be continued).

LOCAL METHOD OF CULTIVATING BETEL-VINE IN KARANJA, BERAR

BY M. N. GOLWALKER, L. AG.

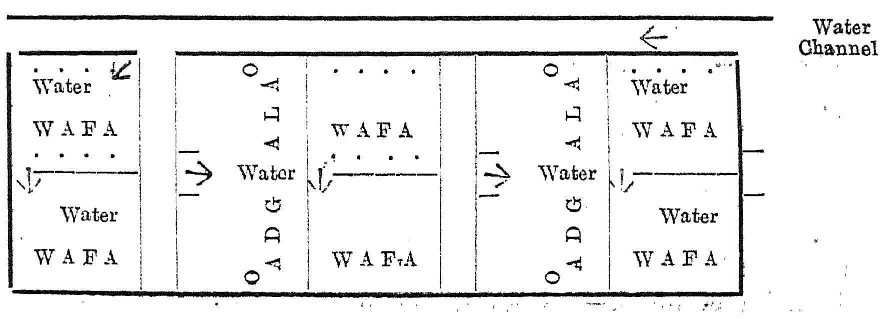
The cultivation of Betel-Vine is more or less restricted to a certain class of cultivators known as *Baris* or *Kanadis*, who as a rule, carry on this as a profession. The cultivation of this crop is restricted to localities where

ample irrigation facilities exist. Owing to its high cost of cultivation and the great amount of care and vigilance required for its successful cropping, the 'Pan-grower' generally restricts the cultivation of this crop from a few *gunthas* to an acre of land. Due to the high returns that are secured from the cultivation of this crop the Pan-growers are generally counted among well-to-do cultivators.

Soil.—The soil requirements are well-drained *rabi* land (rich heavy loams) preferably of red colour.

Preparation of land.—The land is ploughed in the hot weather and harrowing is done with a view to break the clods and level the surface. The plot is then manured with cattle-dung. Forty to sixty cart-loads are generally applied per acre to secure a thick layer of manure on the surface. After the first rainfall the operation of harrowing is repeated until the land is quite free from weeds.

Lay out of beds.—The land is then divided into rectangular blocks known '*wafas*' and '*adgalas*' which measure approximately $10\frac{1}{2}' \times 5\frac{1}{4}'$. The two *wafas* adjoin each other lengthwise and are separated from other *wafas* by an *adgala* as shown in the diagram below:—



Sowing seed of plants to support the vines.—The seed of *shewri*, mixed with little quantities of *hatga* and *tarwad*, is sown along the plot boundaries after the commencement of the monsoon in '*Mrig* or '*Ardra*'. When the plants attain a height of nearly 3 feet they are earthed up on all sides. Plantains are also planted in the *adgalas*, one on each side of the water channel, to supplement the income.

Planting of Vines.—Vines are generally planted during the months of *Shrawan* or *Vhadrapada* (August—September). Cuttings measuring $1\frac{1}{2}'$ to $2'$, with well developed buds are planted into the *wafas* and *adgalas* taking care not to allow the total number of vines to be planted in two *wafas* and one *adgala* to exceed 15 or 17. Vines are planted in very narrow furrows cut into

the soil with the help of the sickle. One end of the vine is buried deep into the furrow while the other is nearly 10″ above the level of the ground resting on the *shewri* plant. All the leaves are removed from the portions of the cuttings that are buried in the soil.

Irrigation.—Vines are planted first and then irrigated once a day for seven days continuously. Irrigation is not stopped even if it rains heavily. After the lapse of a week irrigation is stopped for one day and resumed on the next day and then again stopped for two days, repeating it for a day and again stopping for three days, thus every time increasing a day of stoppage till its duration reaches that of seven days. Though the stoppage of irrigation is increased by a day at each time, vines are never irrigated for more than one day after each stoppage of irrigation. After this period irrigation is done once a week *i.e.*, irrigating vines for a day and then stopping it for seven days. This process is continued till the approach of summer when irrigation is done according to the requirements of the crop.

Top-dressing with silt and manure.—Silt and cattle-dung manure are applied as top dressing in the hot weather following the planting. Silt from fields, *nallahs* or tanks is spread at the rate of 5-10 baskets per *wafa* and the plots are then copiously irrigated.

After care.—The plants are allowed to grow for a period of full twelve months and no leaves are removed during this period. The vines are then separated from the *shewri* plants, and are arranged in circular coils, which are then partly buried in the soil, allowing the exposed portion to sprout. New shoots sprout and give rise to short branches called *hatwan* and the main stem *yelwan.* The short branches do not grow more than a couple of feet while the main stem attains a considerable length.

Removing of leaves.—The leaves are plucked from bottom to top every fortnight or so. The total number of leaves which are gathered from two *wafas* and one *adgala* amounts to nearly 4,000 at each gathering. The growth of vines is retarded during winter but new leaves begin to appear by the beginning of summer.

Duration of Plantation.—Although the plantation lasts for a good number of years the crop deteriorates after the lapse of five years when it is replanted in fresh land. The area under-betel vine is best rotated with turmeric.

Net Profits.—The figures of net profit per acre vary considerably. It is estimated that the total net income exceeds Rs. 2,000 per year while the cost of cultivation and upkeep approximates nearly Rs. 600 per acre.

Notes

THE LAXMINARAYAN BEQUEST

The princely bequest of the late Hon'ble Rao Bahadur D. Laxminarayan to the Nagpur University constitutes a land-mark in the industrial evolution of this province. The Total value of the bequest is estimated to be about 38 lakhs and is expected to give an annual income of over 2 lakhs by way of interest. The central purpose of the bequest is the teaching of applied science and chemistry to the Hindu students domiciled for not less than 6 years in the Central Provinces and Berar. To arrive at a suitable scheme to give effect to the purposes of the testator, the University appointed a committee consisting of some of the eminent scientists, industrialists and educationists of India. The committee has recommended the establishment of a Technological laboratory named "The Laxminarayan Laboratory" in or near Nagpur for the teaching of Industrial chemistry, Geology, Mining and metallurgy and Engineering technology. They have suggested that a beginning be made with oil technology. This latter is an industry of considerable potentiality in this province. During the year 1030-31 this province had 1,906,434 acres under oil seeds representing 8 per cent of the cropped area and during the same year she exported 53,66,707 Mds. of oil seeds valued at Rs. 1,38,57,503. The export of this enormous quantity of raw material is not without serious consequences. Much of the oil seeds that we export is reimported in the form of finished products such as vegetable *ghi*, soaps, paints, varnishes etc. If instead of exporting the oil seeds and reimporting the finised products we could work them up in this country it would result in a two fold benefit. It would hasten the industrial development of the province, thereby helping to solve the problem of unemployment, and it would also have very beneficial effects on agriculture by adding to the available supply of cattle food and manure in the form of oil-cake. So the decision of the committee to make a beginning with oil technology is a matter of considerable importance to the agriculture of this province and it is hoped that the executive Council of the University will give effect to the recommendations of the committee without much delay.

THE WHEAT POSITION

The Twentieth Report of the Imperial Economic Committee makes a general survey of the wheat situation throughout the world in 1931. The report points out that since the close of the war wheat production has greatly

increased. Just before the war the world's annual crop was about 3,000 million bushels, leaving out Russia and China. This dropped considerably during the war. The European countries which produced half the world's wheat diminished their output by one-third. Outside Europe, the war gave a stimulus to increased production. Since the close of the war Europe has regained her old level of production. The five non-European wheat countries have continued to increase and now produce 2,000 million bushels, where before the war they produced 1,500 million bushels.

While production has increased steadily the prices has fallen steadily. In 1930 wheat was being sold for about two-fifths of what it fetched in 1920. This phenominal fall is due to the general causes that have brought about the fall of all commodity prices, rather than to any special cause affecting wheat alone. The re-appearance of Russia as an exporter of wheat and the large surplus stock amounting to about 450 million bushels held by the Federal Farm Board, U. S. A. had undoubtedly had a great depressing effect on wheat. The demand for wheat has nevertheless increased owing to growth of population and increasing consumption in some parts of the world, particularly Russia, the Orient, and tropical countries.

During the last eighty years wheat has lost ground compared with other commodities and has shown a more than average tendency to fall in prices. The purchasing power of wheat over other commodities has declined by about four per cent, yet its cultivation had progressively extended because the cost of production has fallen as well, owing to advances in biological, engineering and transport methods. The reaper, the binder, the harvester-thresher, and the tractor have tended to cheapen production. Through mechanised farming remarkable economies accrue to individual farmers who are freed from the need to pay high prices for seasonal labour. There is a rise in production per head and a decline in the volume of agricultural employment. It is the day of the large farm unit.

The general conclusion follows that while population is not expanding rapidly wheat is being produced more and more cheaply in ever increasing quantities and the outlook is one of continuous struggle between farmers who can adopt the new technique and those who fail to do so, and of fierce competition involving low prices.

WHERE OUR ROOTS ARE

Mr. Henry Ford, the famous manufacturer of Ford Motor vehicles, has great faith in land as the sheet anchor of human civilization. In an article he recently contributed to the American press he says. "The land, that is where our roots are. There is the basis of our physical life. The farther we

get away from the land the greater our insecurity. From the land comes everything that supports life, everything that we use for the service of physical life. The land has not collapsed or shrunk in either extent or productivity. It is there waiting to honour all the labour we are willing to invest in it, and able to tide us across any dislocation of economic conditions. No unemployment insurance can be compared to an alliance between a man and a plot of land. With one foot in industry and another foot in the land, human society is firmly balanced against most economic uncertainties. With a job to supply him with cash and a plot of land to gurantee him support the individual is doubly secure. Stocks may fall, but seedtime and harvest do not fail."

But seedtime and harvest do fail in India and some times with a certain amount of callous regularity. Nevertheless Mr. Ford is on the whole right.

SUGAR PRODUCTION IN INDIA—1931

There are at present 33 concerns in India equipped for refining *gur* or raw sugar, out of which 19 factories also manufacture sugar direct from cane and 14 work with raw sugar alone. Of the former only 3 refined *gur* during the year 1931, and of the latter 7 worked during the year. 4 were silent and returns from 3 have not been received. There were thus 10 factories refining *gur* as against 11 factories during the year 1930. Of the 10 factories that refined *gur* during the year 1931, 5 are situated in the United Provinces, 3 in Madras and 1 in the Punjab.

The figures of *gur* or raw sugar melted, sugar manufactured and molasses obtained in the whole of India during the year 1931 are given below:—

Gur or raw sugar melted	...	15,71,625	10,20,103
Sugar manufactured	...	8,65,364	5.75,709
Molasses obtained	...	5,36,871	3,51,123

The total quantity of sugar produced by factories making sugar direct from cane for the two years 1930-31 and 1929-30 are as follows:—

Years.		*Mds.*		*Tons.*
1930-31	...	32,62,574	or	1,19,859
1929-30	...	24.43,486	or	89,768

If the quantity of sugar refined from *gur* or raw sugar in India by modern process during these two seasons be added to the above figures the total production in the combined seasons will amount to 41,27,938 mds. or 1,51,650 tons. in 1930-31 as compared with 30,19,195 mds. or 1,10,918 tons in 1929-30. (*Agriculture and Live stock in India.* Vol. 2, 1932).

Extracts

CLEAN MILK BETWEEN THE COW AND THE CONSUMER

By J. C. McDougall, M.A., B. Sc. (Edin.) I.A.S.

(Abstract of a lecture delivered before the 8th annual conference of the C. P. Veterinary Association.)

Mr. McDougall started his talk by referring to the pitiable inadequacy of the milk supply in India. He pointed out that for each individual in the Central Provinces there was available only about 3 ozs. of milk a day, that is an amount insufficient alone to keep the smallest baby alive.

Milk is a perfect food for the maintenance of life and for the production of energy. That applies, unfortunately not only to human beings but also to those organisms which are in some cases the enemies of life. The audience were reminded that almost all the harmful bacteria grew and flourished on a milk medium.

In dealing with clean milk the speaker divided the subject into sections.

The first section was devoted to the study of the causes of an unclean supply. This was further subdivided into infection within the udder, infection during milking and infection during distribution.

The various means of soiling milk by diseases of the udder, by air dust and by dirty milkers or dirty utensils were elaborated.

It is known, however, that over 30 per cent of the contamination of milk occurs after it leaves the place of production. Stress was, therefore, laid upon the conditions favourable to bacterial infection and growth brought about by unclean vessels, exposure to air, dust and flies and the storage at unsuitable temperatures.

Mr. McDougall drew a sorry picture of the rather appalling conditions under which milk was produced in the cities. He recommended the rural production and cited an example of a milk corporation operating in India to-day. This corporation very wisely has its milk produced in rural conditions and only distributed from its city centre.

It was pointed out that some of the contamination of milk was wholly preventable and some only partially as we could not have a surgically clean atmosphere or a mechanical cow that could be sterilized.

In a telling phrase the speaker defined clean milk as follows "Not merely milk which contains no visible dirt but raw milk from healthy cows produced

under hygienic conditions containing all its natural constituents and the smallest possible number of bacteria."

In the next section of the paper was discussed the methods by which clean milk could be obtained. Great importance was given to efficient conscientious supervision and rigid insistence on the personal cleanliness of all connected with both byre and dairy. That healthy cows should be kept in healthy conditions seemed to need no elaboration, but it was pointed out that whenever practicable cows should be milked in a stable separate to that in which they ordinarily lived and were fed.

The necessity for an adequate supply of clean water and of properly constructed vessels and containers was dealt with at the length such important considerations necessitated.

In the dairy likewise, Mr. McDougall said, there must be absolute freedom from the least trace of dirt or dust and he pointed out the necessity for good floors, fly-proof windows, clean benches and clean apparatus. In a similar manner he emphasised the need of the greatest care in the storage of milk in the consumers' house and in the handling of it by the consumers' servants.

The next portion of the talk was given to a description of the methods of preserving milk by heat. Pasteurization, by raising the temperature of the milk to 145° F. for half an hour or to 160° F. for a few minutes and then rapidly cooling to 45° F. was explained.

Our attention was also drawn to sterilization by steam at 220° F., and to the more elaborated Mentor Process in which the milk is first pasteurized at 160° F. then homogenized and finally subjected to steam pressure at 230° F. for 35 minutes.

Mr. McDougall concluded by stating that, when any form of after-treatment of milk was adopted to cleanse it, some of its properties were possibly affected, and he reiterated his remarks that the best food for the maintenance of health in mankind was the natural milk from healthy cows produced under scrupulously clean conditions and properly stored. *(Central Provinces Veterinary Journal)*

AGRICULTURE AS AN INDUSTRY

BY SIR DANIEL HALL, K. C. B., F. R. S.

Though agriculture is the most primitive of the industries, for it began, when the wandering hunters or pastoralists fixed their abode for the seasons cultivation, it is never regarded as one with the other industries, but as an

occupation apart. The categories of agriculture, commerce, and the industries are adopted by the economist as by the man in the street.

This is because it has never shared, except to a very limited extent, the concentration which has become characteristic of the industries proper, ever since the power factory began to swallow up the home crafts and domestic workshops. Broadly speaking, the food production of the world is done on peasant farms, worked by one man and his family, with perhaps a little extra labour at harvest. The size of the holding thus occupied may vary very greatly. In the wheat-belt of Australia the one-man farm may be 1000 acres, in the Middle west the typical holding is a quarter block of 160 acres. In Europe, on fair cultivable land farms of 10 to 20 acres are very general. The extreme cases are met with in China, Japan and India, where the holding may be no more than two acres, but is still the sole support of the family. In parts of China may be found densities of rural population upto 3000 per square mile, of whom 90 percent may be engaged in the cultivation of the land. As a general correlation, one may say that the output per acre increases as the holding gets smaller, but the output per man increases with the size of the holding. The single-handed Australian wheat-grower will produce upto 3000 bushels per season; good English production, apart from recent examples of power farming, will average about 1200 bushels per man employed.

Almost as a necessary corollary, it follows that the greater the subdivision of the land in a self-supporting community the greater will be the proportion of its population engaged in cultivating the land. One can contrast the position in parts of China mentioned above with France, which before the war was almost self-supplying as regards food and had about one half of her population on the land. In Great Britain only about one-tenth of the population are employed in agriculture, but less than half the food the country consumes is produced there. As farming is now being conducted in Western countries, about $2\frac{3}{4}$ acres of land is cultivated to produce the food and other agricultural products required by one unit of the population.

In Great Britain there has been from comparatively early times a drift away from peasant farming towards a capitalist system, with a master and labourers receiving a weekly wage. In the older farming of at least the East, Midlands, and South of England, the land was laid out in open arable fields sub-divided into acre strips. Each field carried the same crop on all the strips, there would be for example, a field of wheat, another for barley or beans, and a third in fallow. Turnips and other fodder crops were unknown, the live-stock pastured on common grazings and the waste of the manor, and on the arable

land after harvest. Each tenant of the manor had a certain number of strips, more or less scattered, in each field; these he cultivated himself and took, the produce of. Enclosure—the division of these common fields into separate holdings and private ownership—began in Tudor times because the high prices of wool, then the staple export of England, tempted men to exchange cultivation for sheep-grazing. The process of enclosure went on apace in the seventeenth, eighteenth and early nineteenth century, because the growth of commerce and industry made demands for food which could only be satisfied by the improved cultivation of the land that was possible with enclosed fields. A few examples of unenclosed land still survive—e. g. Laxton, Northamptonshire and the Isle of Axholm; and on the heavy clay pastures of the Midlands one can still see the ridges and furrows of the old common fields.

The output from the land must at least have doubled as a result of the new farming that came in with the enclosures. At the same time the small peasant holdings began to be put together into larger farms. The unsuccessful peasants mortgaged their holdings in bad seasons and had to part with their land. They either sank into rural labourers or got away to the growing industries and commerce. In England from Tudor times there were always openings for men in other occupations than farming, and a continued drift from the land in consequence. We can see the results of this slow "rationalization" of our farming in the present distribution of the land; in 1924 exactly two-thirds of the cultivated area of England and Wales was held in farms of 100 acres and upwards. These larger farms employed on the average 2¾ men per 100 acres, so that if we take the typical English farm as one of 300 acres, the enterprise would be a case of one master and eight labourers. Such a distribution of the land into common fields divided into strips was probably general throughout the greater part of Northern Europe. The organization of farming into larger units has advanced more in Great Britain than in other countries, but the capitalist holding with wage-earning labourers is to be found in all the western European countries, though, except perhaps in southern Sweeden, it is not the typical form of land holding. Really, large scale farms organised on an industrial basis are rare. There are great "domain" exploitations among the large landowners of East Prussia, but the similar estate farms of Poland, Czecho-Slovakia, Rumania etc., have to a large extent been divided in response to agrarian unrest during the war. In Great Britain there are a few men in control of considerable areas, upto 12,000 acres, but as a rule the farms thus constituting a single business still appear as separate holdings in the agricultural returns and are managed individually only the buying and selling are centralized. It is only in some of the plantation industries—sugar, rubber,

cotton, tea and coffee, etc., and again in certain forms of market gardening in this country and America that anything comparable to factory organization can be found. In Russia the five years' plan for agriculture aims at replacing the old peasant cultivation in small units by extensive industrialized exploitations, but while it is clear that great advances in production have been realized, information is as yet unavailable as to the financial results or the stability of the experiment. It is noteworthy that the joint-stock enterprise is very rarely to be found engaged in general farming, and agriculture is thus cut off from the normal source of capital. In Great Britain farming is financed by private capitalists, assisted by bank overdrafts and credit from dealers, though of course, under our renting system the landlord carries the bulk of the fixed capital.

Certain consequences follow from this predominance of the family—farm in the business of food production. The individuals are weak commercial units. In so far as the products are not sold direct to consumers (*e. g.* the milk supplies to northern English towns, where the producer also has a round and sells from his cart), and have to enter the general stream of commerce for distant transport and export, there springs up a loose organization of dealers who collect the small parcels, grade and bulk them. The producers are powerless against the dealers, who pay no more than will serve to keep the farmers in being. To some extent this dependence upon the dealers has been relieved by co-operation among the farmers, but co-operation is slow of growth, and has proved easy of organisation only when the producers are working for an export market. Nor does co-operation remove the mechanical disadvantages of the small farm, its inadaptability to the use of power machinery and the economic organization of labour. Where the land is much divided it becomes difficult to carry out extensive schemes of land improvement such as drainage, of which the collective advantage may be great, though the individual advantage may be unequal and deferred. The strength of the peasant system lies in the willingness of the occupiers to work long hours, in the unpaid labour of the other members of the family and in the scope it gives for individual contrivance and economy. But even this latter virtue is discounted by the fact that peasant farmers regarded as managers of a business are unselected and constitute a random slice of the community whereas the manager of an industrial enterprise is a man picked for his directive ability. The average performance of a group of peasant farms must therefore be low even as the average character of intelligence of any random group of men is low. Peasant farming is inevitably highly conservative, dominated by traditional practice, and but slowly receptive of new knowledge or scientific methods. Indeed as compared with the great industries, peasant farming affords little scope for the

application of scientific research. New fertilizers or improved varieties produced by the plant breeder can readily be demonstrated to the farmers, and will be adopted by degrees according to the intensity of the propaganda. But changes in the system of farming are less capable of demonstration, and often the results of scientific investigation require a prolonged period of working out before the laboratory conclusions lead to a practical process. This intermediary stage is normal in factory enterprise, but is quite impracticable in a system of small units. To take an example, genetic science indicates the way to considerable improvements in the breeding of livestock but the experimentation and selection would require work on thousands of animals over a period of years. There is under the existing system of farming no possibility of financing the preliminary work nor of being repaid for success. The only method by which the peasant farms can be linked up to a large directed enterprise is to tie them to the processing factory, and make them work to a schedule.

One may sum up the situation by saying that peasant farming is a mode of living rather than a business for profit, and that the food, etc. on which the urban population depends are little more than the by-products of the peasants' activities.

Broad consideration of economy of man-power must exert pressure in the direction of building up large farms on which the cheapening of production would be effective and would make profits. But farming is still so much of a mystery that the capitalist has always been shy of venturing into it, and the cutting of prices to which the peasants are subject keeps wholesale prices down, until the margin of profit to tempt the capitalist into the business is less than might be expected. In this country, again skilled managers capable of handling a 10,000 acre unit would be hard to find, because, there has been no opportunity for obtaining experience of the kind. A man may be an excellent manager of even 1,000 acres which he can keep under his own eye, and yet lack the organizing ability to deal with ten times that area. Of this failure examples are not lacking. Nor under existing conditions would it be easy to obtain blocks of the land suited to such a purpose. English land is still subdivided into a number of ownerships, many of them held for non-economic reasons. On any estate the woodlands, shaws, and spinneys are numerous, and though producing little in the way of timber, are valued for game, and would have to be purchased at an uneconomic price. An estate managed for production would want to remove both them and the hedgerows, but the capital expenditure would relatively be excessive, and would only slowly give returns. In other parts of Europe where the land is still more subdivided and where peasant ownership is general, the obstacles to the creation of large farming units are far

greater; any general movement in that direction would create a social upheavel. So far from adopting a policy of the kind, however, consistent with a planned national economy, continental nations are in general committed to the preservation of peasant farming by means of protective duties to maintain prices and obviate the competition of the newer countries with extensive cheap production. In France, at the moment of writing, the wheat growers are demanding Government aid, and organising themselves to withhold wheat from the market because the price has fallen to 120 f. per quintal. This is equivalent to 14 s. per cwt., the world price being 6 s. to 7 s. per cwt. in Europe, and the price that is being guaranteed to English farmers by legislation being 10s. per cwt. In Czecho-Slovakia the internal price of sugar from beet is being maintained at about three times the price at which the surplus (nearly one-half of the production) is being sold in the world market, largely to Great Britain. Of course, duties also enter into the internal price of sugar, but the fundamental fact is that the Government dare not abandon the peasants to the play of the open market, and sugar beet is an essential feature in their cultivation.

No citizen, rural or urban, but has to reflect upon those matters. An adequate food supply is the basis of civilization, and every state has to consider how to maintain it. Even in easier times than the present world depression the complaints of the farmers about inadequate returns are general in every country; it is necessary that their position should be one of reasonable prosperity, because their demand for commodities really sets the ball of trade rolling. We may dismiss the idea of overproduction, save as a temporary and local affair. The demand upon the farmer is almost infinitely elastic; not that the consumers can eat more, but because with every expansion of income the demand shifts to better types of food which call for more labour in their production. The present Orientals would like to exchange rice for wheat, just as the Baltic peasant would forego rye if he could afford wheat; a very large proportion of the working classes of all countries live mainly upon cereals, and wish to increase the meat and milk in their dietaries; the English housewives buy more vegetables and fruit as wages increase.

During the last sixty years the wages of the British working classes have been steadily rising, at the same time the prices of the prime food commodities were equally falling, and again are approaching the pre-war levels. But the response has not been so much a reduction in the gross expenditure of the family upon food, as a demand for kinds of food that were previously beyond the income available to large classes of the community. The average consumption of meat and milk has increased, still more have vegetables and fruit, hitherto almost luxuries, become part of the dietary of all classes. In

the farming of the country these changes are reflected in the increased product-ion of live-stock products at the expense of cereals, and in the growth of market-gardening and fruit production. Apart from the increases of population, the demand upon production from the land is increased rather than diminished by this alteration in the standard of living. As the collective demand shifts from cereals to meat and the corresponding shift in relative prices induces farmers to convert their cereals into meat, the total draught from the land is increased, because the gross nutritive power of the meat is much less than that of the cereals from which it was manufactured. In an ordered national economy, if such a thing is feasible, in a state organized for efficiency like an engineer's layout, there is a clear gain of man power when as small a proportion as possible of the population is engaged in the prime business of producing the food the community requires. Probably 10 per cent of the population could do this under organization, and yet maintain the existing standard of living. But the vision of an ordered world is very far away; at present most statesmen in the world are intent upon reserving the peasant population and on maintaining, if not increasing the number of men living on the land. The peasant population constitutes a stable element in the community, one that is socially valuable in many ways. A peasant population, even the old rural communities which have so very largely perished in Great Britain, has is social organization, "a culture" of its own which very few people wish to exchange for the amorphous aggregates of wage-earners characteristic of the great industrial towns. So the small farm is protected even at the cost of dearer food for the rest of the community. The alternative of a reconstruction of the land system is too gigantic a task for any statesman to contemplate; few people are to contemplate social revolution on Russian lines.

But ultimate economy of production lies with the large organized farm, and economic pressure ultimately and, however slowly, has its way. In the past it has transformed the mediaeval land system of England with its open fields and common farming into private ownership and agricultural units of moderate size. It is not to be supposed that such change is at an end, but it may be presumed that as it arises in response to economic pressure it will be a gradual transformation, without sudden dislocation or hardship to any considerable section of the people. Political action may at times accelerate and at times delay but the course of English history leads one to anticipate that it will do little more than register the changes that have already taken place in men's opinion and mode of living. (*The Empire Cotton Growing Review*, October 1932).

Gleanings

The King of Ploughs.—What is said to be the largest plow in the World has been operating in Orange County, California, and is described by A. A. Young, assistant irrigation Engineer, of the United States Department of Agriculture stationed at Santa Ana. It is the only plow of its kind and was designed and built to meet an unusual condition existing in the lower Santa Ana River valley adjoining the seacoast.

Originally this area was fertile land, but overflows from the Santa Ana River during floods deposited one to two feet of sand upon the rich soil and made it useless for crop production. Later this sand deposit was covered by a growth of Bermuda grass.

The plow is intended to turn the sand under and bring the rich soil to the top. It has two shares. The smaller one, which is of good size, is set forward and higher than the larger share which is able to plow a furrow 36 to 42 inches in depth and three feet in width. The forward share turns the surface sand and Bermuda grass into the deep furrow where it is covered by the fertile soil turned up by the larger share.

The plough is four feet high and 22 feets long. At turns, it is raised and lowered by a hydraulic lift. It is reported to weigh about one ton and to have cost 2000 dollars. It is drawn by three heavy tractors running in low gear and is reported to be capable of plowing five acres a day. (*Scientific American*).

Value of Deep Tillage.—The only true test of good farming is to produce the maximum yield per acre at the minimum cost consistent with good farming. This yield will never be obtained unless the soil is well and truly tilled. Deep tillage on the rich easily worked loams is as good as a coat of dung, for no land can make the best use of manure unless it is suitably prepared to receive the dressing. Again, no amount of merely mechanical working will make the soil fertile unless organic manures, such as dung, or green manures, such as crops of mustard, tares, and clovers, are occasionally ploughed in. Moreover, artificials are needed in addition to the organic manures, for they provide the plant with nourishment that is easily available and ensures it having a kick-off at the start of its career. The soil is the farmer's raw material, and must be treated well if it is to give a paying return, whether this return be in crops or in grass—(*" Live stock Journal " England).*

Circumstances affecting the quality of milk.—A new Advisory Leaflet (No. 29) issued by the Ministry of Agriculture and Fisheries (Great Britain)

gives some useful and interesting notes on circumstances affecting the quality of milk.

Dairy breeds differ widely in regard to the quality of milk, and there are also individual differences with a breed. The ability to produce rich or poor milk seems to be hereditary, this trait applying equally to both parents. The herd owner who wishes to grade-up his herd should, therefore, keep careful yield and quality records of the milk produced by each cow, so that he may be guided in the selection of the cows from which to breed, and he should also exercise every care in the selection of the sire. If the owner favours a particular breed on the ground of quantity production, and desires to raise the average quality of the milk of his herd immediately, it is usually advisable to include a few animals of a "high-quality" breed, such as the Guernsey or Jersey.

Interval between milkings :—Uneven intervals between milkings are, perhaps, the commonest cause of wide variations in quality, the butterfat easily varying to the extent of 2 or 2.5 per cent. The farmer should aim at a night interval of not more than thirteen hours, and the heavy-yielding cows should be milked last in the evening and first in the morning.

Quality is often affected by the inefficient milking. Milking should be done quickly, quietly and thoroughly, the cow being treated with every consideration. Thorough stripping is essential, as the fat content of the last milk so obtained is often as high as 7 to 8 per cent. Moreover, rough stripping will result in loss of butter fat and injury to the udder muscles.

As the chemical quality of milk from individual cows varies, the milk should be bulked in the churns so as to represent the average quality of the herd. Any high quality cows should be so housed as to ensure an even distribution of their milk throughout the bulk. Proper bulking is particularly important where milk is bottled on the farm ; neglect of it has led to wide variation of fat content in the highest grades of milk.

Contentment, which is fostered by comfortable housing, ample light, and ventilation tends to increase the general quality of milk produced. The quality is often affected by indisposition, recent calving, chill of the udder, abnormal conditions, and any unusual excitement. The general condition of individual cows should therefore, be kept under observation by stockmen, and during any abnormal period the milk should either be tested or withheld temporarily from the bulk.

Balanced Rations :—Experiments have shown that if a cow is well nourished no alteration or improvement in feeding will permanently alter the quality of her milk. Where, however, a herd is receiving an unbalanced

ration containing too great a bulk, too much starchy matter or oil and an insufficient albuminoid and mineral content improved feeding may raise the general quality of the milk, particularly in the case of a solids-not-fat deficiency.

The solids-not-fat content is sometimes adversely affected when the herd is turned out to spring grass. The reason has not yet been ascertained, but in the meantime it would seem worth while to try the judicious use of suitable concentrates, preferably those low in albuminoid content. Similar care is needed towards the end of the grazing season.

There is frequently a slight depreciation of chemical quality when lactation is extended beyond the normal period (nine to eleven months) and in abnormal old age. These factors are unlikely to influence the quality of milk from the whole herd unless the average age of the cows is unduly high and calving-down is practised only at certain periods of the year. In such cases, the remedy is simple and obvious.

It is improbable that all the above factors will be found in any one herd, but where the chemical quality is low some of the factors will probably be present. The exact cause can be determined only by investigation, based on reliable information. Accurate records of yield, fat content, and solids-not-fat content for the herd as a whole and for individual cows are, therefore, essential. Any producer who experiences difficulty in keeping such records, or requires advice on rationing, should approach the County Agricultural Organiser, who is available to give expert advice and to assist in improving the general standard of milk production.

Granular Fertilizer.—A new kind of fertilizer, extremely concentrate in its content of plant food and produced in granular form, was recently announced by Theodore Swann, President of the Swann Corporation.

Said President Swann, "The advantages of a highly concentrated fertilizer are evident when we consider that farmers are paying 30,000,000 dollars annually for transporting and handling ordinary fertilizer, 84 per cent of which is inert matter and of no plant food value. The new fertilizer contains 64 per cent or more of nitrogen, phosphoric acid, and potash, against the 16 per cent found in commercial fertilizers.

" In developing this fertilizer, our chemists have solved a problem that has engaged the attention of agricultural chemists for many years," Mr. Swann continued. "When plant foods are merely mixed together in the ordinary manner, they tend to absorb moisture and to cake. They also tend to separate out of the mixture in non-uniform masses. With high concentrations, the fertilizer is therefore apt to be very difficult to apply and to distribute uniformly.

"This problem has been solved by producing the new fertilizer in granular form. The granules are hard and firm, uniform in composition, dustless, and non-caking even in damp, humid climates."

"Their size and shape permit them to be easily and accurately applied to the soil by means of the simplest type of mechanical distributors. Recent tests show that the granular form of this new fertilizer permits uniform distribution at a rate as low as five pounds per acre, which is a degree of uniform application that has not heretofore been obtained (*Scientific American*).

A new use for Skim milk.—Where Butter is the principal dairy produce skim milk is a by-product and the disposal of it is a serious problem sometimes. Some dairymen have begun to realise that it is profitable to use this by-product to feed the cows that produced it. The cows require protein and it is generally supplied in the form of oil meals. The skim milk contains much of the protein which the Dairy cow consumes. Though less concentrated than in an oil meal it is in a more readily available form. Recent feeding tests at the university of Minnesota indicate that eight pounds of skim milk will take the place of one pound of linseed oil meal.

Feeding skim milk for its protein to the cows that produced it produces a circular movement of milk from the cows to the separator and back through the cow to the milk pail. Each time it passes through the separator it skims the cream and sends the milk back to gather more cream within the cow. Few cows will drink the skim milk if it is offered to them unmixed with some other food. The practice at Minnesota station was to mix the skim milk with the grain feed in a pail and then pass it over the silage.

Gassing fruit delays spoilage.—Exposure of warm fruits and vegetables to carbon dioxide gas during the first 24 to 36 hours after loading in a refrigerator car may prove a valuable aid in preventing deterioration and spoilage. The United States Department of Agriculture has found that carbon-dioxide checks the decay and softening of fruits and helps to maintain the sweetness and freshness of such products as sweet corn and peas, but that exposure to the gas over too long a period must result in objectionable changes in flavor. The flavor of peaches, apricots, strawberries, and red raspberries has sometimes been damaged by exposure to 25 percent or more of carbon dioxide for a period of 24 hours, where as plums, cherries, pears, apples, peas, and corn are much more resistant to carbon dioxide injury.

The carbon dioxide treatment may be given by using solid carbon dioxide along with the ice in the standard refrigerator car. *(Scientific American.)*

Current Research

Catadyn, a new sterilizer for use in the Dairy.—J. H. Walton and and C. S. Rama Iyer. (*Agriculture and Live Stock in India*, Vol. 2. 1932 pp. 499-506). This new sterilizer has been placed on the market in India for use as a water sterilizer. It is supplied in several forms namely as an earthenware carafe, coated sand or pellets. The water to be sterilized is either placed in the carafe or brought in contact for a short time with the sand or pellets. The sterilizing action is carried out by a coating of silver in a special finely divided condition on the carafe or pellets thus exposing a great surface of silver to contact with the water. It has long been known that the Bacteria in water kept in vessels of silver or certain other metals gradually die off and after some days the water becomes almost or quite sterile. By the catadyn method the sterilizing action of silver has been raised from a laboratory curiosity to a method of every day practical utility. Certain tests were carried out at Pusa to find out if catadyn could be of service to the Dairy industry in India as a substitute for the costly method of steam sterilization.

As a water sterilizer catadyn is very efficient and for domestic purposes is far less troublesome to use than any chemical for the provision of a safe drinking water. Its use in the dairy can be strongly recommended as an aid to cleanliness especially for marking and sterilizing bottles and other utensils. They hope to develop a method of employing catadyn so that it may make unnecessary to use steam or chemicals for the sterilization of dairy utensils and milk bottles.

A study in sampling technique with wheat.—By R. J. Kalamkar, Ph. D., (*The Journal of Agricultural Research*, Vol. 22, 1932). In conducting field experiments in co-operation with farmers, experimental stations very often encounter difficulties in having test plots properly harvested and threshed. Estimation of the yield of experimental plots by harvesting a number of very small, apparently representative areas, consequently becomes desirable and necessary where facilities are lacking for harvesting or threshing accurately the produce of the entire areas.

Five sampling methods are studied in the present paper. In each case the ultimate part of a sample designated as a "unit" is a half-metre length of drill. The "sampling unit" comprises four "units" and thus occupies two metre lengths. The five methods, however, differ from each other in the scatter of the four units comprising the sampling unit. Of these, methods (1) in which the "sampling unit" consists of four parallel half-metre lengths on

adjacent rows, appears to be the most precise, and may be recommended on the basis of this trial. The half metres within such sampling units appear to be negatively rather than positively correlated, and a significantly lower sampling error is obtained in consequence

The Marketing of Agricultural produce in the Central Provinces and Berar.—P. D. Nair, *(Indian Journal of Economics*, Vol. XIII, pp. 149-168, 1932). In this paper the author makes a general survey of the conditions governing the marketing of agricultural produce in the province. The markets of the province can be brought under three classes (1) the weekly markets held in bazar village, (2) the big fairs and markets held during religious festivals in sacred places and (3) the wholesale produce markets of the cotton, wheat and rice tract. The first two are only distributing centres mostly concerned with retail trade. The real marketing centres are the wholesale produce markets of the third class situated in Rail head towns at suitable distances. The markets of the Central Provinces are established under the Municipal Act. The municipality collects the market dues and issues licenses to brokers, weighmen and measurers. The central figures in the market are the commission agents through whom the buyer and seller are supposed to act. The sellers, interests are not properly safeguarded in these markets and several unjust deductions are made from the price. The markets of the rice tract however are under the strict control of the municipalities concerned and every effort is made to safeguard the interests of the seller. In some of these markets brokers are entirely done away with and a municipal officer conducts the auction on behalf of the seller. The markets of Berar are organised under the Cotton and Grain Markets Law of 1897. The law has recently been amended so as to remove some of the defects of the original law.

Except in Berar only a small percentage of the growers take advantage of these wholesale markets. The itinerant *bepari* or trader is responsible for a large part of the arrivals in the wholesale markets of the rice and wheat tract. Sale is effected through the *dalals* either by the open auction method or by the secret finger manipulation methods known as *Hatta*. The expenses of marketing amount to a good percentage of the price received in the wholesale markets.

A very large number of middlemen intervene between the grower and the ultimate consumer. In the case of the oranges there are as many as six intermediaries to intercept the profits. One of the most important characteristics of agricultural marketing in this province, nay all over India, is that it is restricted to a few months in the year. The whole produce is rushed into the markets within a couple of months of their getting ready. The result is a

glut and fall in prices and by far the largest part of the produce raised by the cultivators is sold when prices are low.

Silage investigations at Bangalore III. Effect of the stage of maturity on ensilage of jowar.—T. S. Krishnan, (*Agriculture and Live Stock*, Vol. II, 1932, pp. 507-514). Previous work on ensilage was confined to the study of the process using only the usual stage of harvest of the crop. As a continuation of the work, the effect of the stage of maturity was studied. For this the ensilage of the jowar was carried out in the following stages of maturity:—

1. **Immature.**—This is the stage when all the leaves have appeared but the plant has just not flowered.

2. **Prime.**—The usual stage at which ensilage is generally carried out. The grains in the ear-heads are just hardening.

3. **Straw.**—This is the dead ripe residue left after the ear-heads have been removed.

In the immature stage the silage had a good colour and texture, but was not much relished by cattle. It had an acidic smell which was not pleasant and was somewhat sour. The product might be called "acid silage" with a tendency to sourness.

In the prime stage the colour and texture of the product were good. It had a very pleasant and slightly acidic smell. Cattle ate it with great relish. It might be classed as slightly acid "brown silage".

In the straw stage the resultant material had a very fine texture and pleasant pungent acidic smell. It was eaten readily by stock. It can properly be named "acid brown silage".

These experiments lead to the following conclusions:—

1. The prime stage produces the best silage with the least losses.

2. It is more profitable to ensile the straw rather than use it in the raw state.

3. The immature plant is quite unsuitable for ensilage.

Some aspects of the growth of rice in heavy black soils of the Central Provinces.—D. V. Bal and R. N. Misra, (*Agriculture and Livestock in India.* Vol. II, 1932). It has been observed during recent years that there is a growing tendency on the part of the cultivators of some of the rice growing tracts of the province to convert their heavy wheat lands into rice *bandhis* (embanked fields). When heavy soils ordinarily growing wheat are brought under rice cultivation the crop for the first four or five years is very poor. This investigation was undertaken to study the factors that delay the establishment of heavy wheat soils as rice *bandhis*.

Results of the analysis of the light and heavy rice soils of the Central Provinces show that the former possess a lower pH value than the latter.

When a heavy soil formerly under wheat is converted into a rice field, the percentage of lime in the soil is decreased and there is also a corresponding reduction in the pH value of the soil.

Experiments on the growth of rice in sand cultures with nitrient solutions of different pH values indicate that the rice plant prefers a slightly acidic or neutral medium to an alkaline one.

It is seen from the pot and field experiments that the pH value of the soil is lowered by an adequate application of sulphur.

The results obtained from the pot and field experiments on rice indicate that in the case of heavy soils, with a basal dressing of green manure, sulphur gives increased outturn, but an annual Application of super either individually or in combination with sulphur gives decidedly better results.

Availability of phosphates in Bone-meal.—P. E. Lander and Dalip Singh, (*Agriculture and Live-Stock*, Vol. II, pp. 627, 1932).—Many grades of bone-meal available on the market are not sufficiently fine to justify their use at the present time as manures. It is essential that a bone-meal should be "meal" in the true sense of the word, when its available phosphates is shown to be greater than in coarser grades of meal. Inexpensive treatment with urine, farmyard manure, and Ammonium sulphate for three months, demonstrates that the available phosphate in different grades of bone-meal both steamed and unsteamed can be materially increased thereby, and it is therefore recommended for farm practice. Steamed meal is invariably better than the unsteamed. (*Author's summary*).

Carbon dioxide assimilation of the leaves of the rice plant.—(*Oryza sativa L.*) R. H. Dastur and J. J. Chinoy. (*Indian Journal of Agriculture Science*, 2, 431). The research was undertaken to determine the photosynthetic activity of the leaves of the rice plant. The photosynthetic activity of the rice plant was determined (1) by finding the differences between the carbohydrate contents of the leaves in the morning and the evening, and (2) by determining the absorption of carbon dioxide by the leaves under uniform conditions of temperature, light and carbon dioxide supply with a specially fitted apparatus. The results obtained by the methods show that the photosynthetic activity rises soon after transplantation, reaches its first maximum in August, with a depression in September. The photosynthetic activity again begins to rise at the flowering period and reaches its second maximum when the highest point in the assimilatory activity is reached, after which there is a rapid decline in the photosynthetic activity. (*Authors' abstract*).

Crop Forecast

RICE

Second Forecast. 1932-33.—All India—The forecast refers to about 96 percent of the total rice area in India. The total area reported is 78,791,000 acres as against 81,367,000 acres (revised) at this time last year or a decrease of 3 percent.

Central Provinces and Berar.—(7.3 percent). The area sown is estimated at 7,005,000 acres as compared with 7,018,000 acres the revised area of last year. The yield is estimated at 1,974,000 tons as against 2,225,000 tons the revised yield of last year. Heavy and continuous rain hampered the growth of the young plants in the early part of the season but successive breaks interrupted by opportune showers greatly benefited the crop. The season was on the whole favourable. For the province as a whole the average outturn works out to 103 percent of the normal as against 112.5 percent last year.

Rice crop in foreign countries.—The official estimates of the second rice crop of Formosa for 1932 places the area and yield at 943,000 acres and 681,000 tons showing an increase of 6 percent in area and 26 percent in yield as compared with the same crop of 1931.

The estimates of the rice crop of Japan for 1932 is placed at 8,440,000 tons as against 7,744,000 tons last year. The estimates of the 1932 crop of the U.S.A. are 845,000 acres and 761,000 tons showing a decrease of 13 percent in area and 16 percent in yield as compared with the 1931 crop. In Italy the area and yield of rice this year are 330,000 acres and 613,000 tons as against 356000 acres and 644,000 tons in 1931.

LINSEED

The forecast refers to about 92 percent of the total area under linseed in India. The total estimated area under linseed so far reported is 2,483,000 acres (excluding the mixed crop of U. P.) This shows an increase of 4 percent as compared with the corresponding estimate of last year.

Central Provinces and Berar.—(27.4 per cent). The area sown is estimated at 999,000 acres as against 850,000 acres reported at the corresponding date of last year or an increase of 16 percent. Sowings were made under favourable conditions and germination was satisfactory. The condition of the crop is at present satisfactory and prospects are so far hopeful.

Linseed in foreign countries.—The area under linseed in U. S. A. for 1932 is estimated at 26,66,000 acres which is 15 percent above the estimated area of last year. The estimated production of the crop is placed at 295,000 tons which is practically the same as last year. The estimates for the Canadian linseed crop of 1932 are 454,000 acres and 63,000 tons as compared with 627,000 acres and 64,000 tons in 1931. In the Argentine the area sown with linseed during 1932-33 is estimated at 7,401,000 acres which is 14 percent less than the estimate of last year. The first estimate of production of the crop during 1932-33 is reported to be 1.3 million tons as compared with 2.1 million tons reported at this time last year.

JUAR

The following is the final forecast of the *juar* (*kharif* crop of the Central Provinces and Berar for the season 1932-33 :—

Area.—The estimated area (3,943,892 acres) sown this year in the province is nearly the same as the preceding year's actual area (3,952,431 acres) under *kharif juar* but is less than the five and ten years' averages by 1 and 2 percent respectively.

Outturn.—For the province as a whole, the outturn, according to the reports of district officers, works out at 83 percent of the normal. Expressed in tons, the total estimated yield amounts to 9,46,000 tons, which exceeds that of the previous year by 33 percent, but is less than the five and ten years' averages by 1 and 4 percent respectively.

Prices.—The wholesale price of *juar* ruling in the principal markets of the province on the 30th November this year ranged from Rs. 2-3 to Rs. 3 per maund against Rs. 1-4 to Rs. 2-4 ruling on the same date last year.

College News

The annual social gathering of the College was celebrated on the 21st and 22nd of December. The economic depression and the ten-per-cent cut in salaries are responsible for a slight reduction in the scale of our celebration; and perhaps they also account for the absence of any of our old boys stationed in the mufassils. The most important item in entertainment, the drama, was omitted. The celebration started on the morning of the 21st with sports.

The noon was occupied by the finals of indoor games and in the evening a Hockey match was played, the old boys and staff *versus* the present students.

The Hockey match was followed by a Reception in honour of the old boys in the College Hostel. This was attended by most of the old boys in station. The general secretary proposed the toast of the old boys and this was responded to in suitable terms by a number of old boys and then the pleasant function was brought to a close by an interesting speech by the Principal. In the night there was a variety entertainment, the principal items were vocal and instrumental music and the presentation of a few scenes from Shakespeare's Merchant of Vennice, under the able management of our College historian Mr. V. G. Rao. The 22nd morning was taken up by the Tennis Matches.

The elocution competition was not a very brilliant show. The entries were meagre and the standard of performance was not very encouraging.

Mr. F. J. Plymen, C.I.E., Director of Agriculture presided over the prize distribution ceremony and also unveiled the portrait of Mr. R. G. Allan, our late principal. The function was attended by the students and staff of the College and some of the leading citizens of Nagpur interested in Agriculture and the Agricultural College. The Principal opened the proceedings with a short speech in which he referred to the long and unique services rendered by Mr. Allan whom he described as the "*ma bap*" of this College. He also referred to the fact that this will be the last occasion when we shall have the privilege of the company of our president during our social gathering.

The General Secretary then read a short account of the social activities of the College during the year. He also dealt with the necessity for giving the agricultural graduates the same status as other graduates of the University regarding facilities for prosecuting higher studies. It was also suggested that Agricultural graduates should be made eligible for appointments in the executive services in general and Revenue Settlement and irrigation department in particular. This was followed by the distribution of prizes and medals by Mr. Plymen.

Before unveiling the portrait of Mr. Allan the president referred to the valuable contribution made by the early workers in bringing the college to the present state of high efficiency. The portrait of Mr. Allan represents him in one of his characteristic moods, with his inseparable pipe in his hand. It now adorns our College hall and our heartfelt thanks are due to Mr. Allan for his valuable gift.

In his address the president referred to some of the points raised by the General Secretary in his speech. Regarding the appeal of the Agricultural graduates for equal status with other graduates of the University, he said that

an agricultural graduate must have a higher status on account of his specialised training and if after four years of hard and expensive study the graduates in agriculture only look forward to attain a status equivalent to that of the ordinary arts graduate there is no justification for the heavy expenses involved in training them up. Regarding the future prospects of the graduates he emphasised the need for agriculturally trained men to look more and more towards the land as a source for employment. The president and the guests were then garlanded and the party moved on to the grounds of the Research Institute where Mr. and Mrs. McDougall were At Home to the guests.

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The Inter-collegiate debate under the auspices of the Nagpur University Union Society was held in December. The subject was that "Machinery is the bane of Modern Civilisation". All the colleges of the province took part in the debate. We are glad to say that our College scored the second place. We feel proud that Mr. Bhattacharya and Mr. Chaudhary have acquitted themselves so creditably in this sphere of intellectual exercise proficiency in which is not generally associated with the humble tiller of the soil.

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We had another very interesting lecture from Mr. J. Z. Hodge on Rural Reconstruction. The theme of his lecture this time was Gosaba—the settlement of Sir Daniel Hamilton in the Sundarbans. We offer our heartfelt thanks to Mr. Hodge for the interest he has shown in us and for his illuminating lectures.

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It is with deep sorrow that we record the death of Mr. S. Y. Hussain a student of the 1st year. He suddenly took ill here of swollen glands and was soon removed to Bombay. The best medical aid was secured for him and yet it was all to no purpose. Mr. Hussain was a scholarshipholder from the Hyderabad State. He was a good student and a very jovial friend. His premature death is mourned by one and all in the College. May his soul rest in peace!

LIST OF COLLEGE PRIZE WINNERS 1931-32

3RD YEAR

Inter-class ploughing	Competition	Medal, (1931-32)	...	Mr. L. P. Khare
Do.	do.	do	...	„ Mohd. Ishak
Do.	do.	do.	...	„ H. P. Mishra
Chakradeo Prize	...	...	...	„ S. C. Bhattacharya

2ND YEAR

Chaudhary medal ...	...	... Mr. S. L. Nema
Class prize ...	...	... „ D. Misra
Special Prize for Section I	...	... „ G. L. Deshkar
Do. do. II	...	... „ Zafarali Khan
Do. do. III	...	... „ D. Misra
Prize for Dairy Stock Judging	...	... „ H. Misra

1ST YEAR

Class Prize ...	...	... Mr. V. G. Vaidya
Special Prize for Section 1	...	... „ V. G. Vaidya
Do. do. II	...	... „ V. G. Vaidya
Special Prize ...	...	... „ D. Patnaik
Phatak's Agricultural Prize	...	... „ V. G. Vaidya

The College Gymkhana

Our achievements in the direction of sports have not been very satisfactory during the last quarter. In the University sports Mr. Khirey, who broke the University record in the 3 mile race last year, maintained his position. But for the unfortunate chance that a mad dog interfered with his practice to some extent he would have broken his own record this year.

Our thanks are due to Mrs. McDougall who has promised to award a championship medal in tennis every year. Mrs. McDougall's medal was won by Mr. Rashid this year.

The College sports in connection with the social gathering took place on the 21st December. All the items were well contested and the competitors showed great keenness. The list of prize winners is given below :—

1. 100 yards race...	1st	...	Mr. A. M. Chaudhary
	2nd	...	„ R. L. Gupta
2. High Jump ...	1st	...	„ H. K. Das
	2nd	...	„ Y. K. Dabhadkar and „ K. G. Joshi
3. 440 yards race ...	1st	...	„ R. L. Gupta
	2nd	...	„ M. M. Khirey
4. Long Jump ...	1st	...	„ M. M. Khirey
	2nd	...	„ S. S. Ambadekar

5. Shot put	... 1st	...	Mr. A. M. Chaudhary
	2nd	...	,, V. T. Tanksale
6. Hurdles	... 1st	...	,, A. M. Chaudhary
	2nd	...	,, S. A. Rasheed
7. One mile race	... 1st	...	,, D. N. Gour
	2nd	...	,, M. M. Khirey
8. Sack race	... 1st	...	,, A. M. Chaudhary
9. Three-legged race		...	,, Dutt and Mr. Chandel
10. Bullock race ...		...	,, S. K. Dharmadhikari
11. Relay race	... (2nd year)	...	,, S. K. Bhisey
12. Tug of war	... (4th year)	...	,, H. K. Das
13. Cock fight (Mr. P. M. Joseph's prize.)			,, P. M. Ganorkar
14. Volley ball	... 2nd prize)	...	,, P. M. Ganorkar
15. Ping Pong ...		...	,, D. C. Kelkar
16. Tennis doubles (champion)		...	,, P. S. Dutt and Mr. Z. A. Khan
17. Tennis singles (Mrs. McDougall's medal)			,, S. A. Rasheed
18. Tennis singles runner up		...	,, S. Hasan
19. Elocution competition	... 1st		,, T. P. S. Chaudhary
	2nd		,, R. L. Singh
20. Recitation competition	... 1st		,, B. S. Venugopal Rao
	2nd		,, M. S. Nair
21. Individual best sportsman cup (by Mr. K. P. Shrivastava)			,, A. M. Chaudhary
22. University Sports medal (by Mr. B. S. Rao)			,, M. M. Khirey

Mr. Pandit's Farm, Bhandara

BY H. B. MISRA, B. A.

It is customary for the Second year students to go on an excursion to study sugar cane cultivation and *gur* making. This year we had the privilege of visiting Mr. Pandit's farm at Bhandara. Mr. Pandit is one of the leading Lawers of Bhandara and has taken up Agriculture as a side show; and by virtue of the improved methods he has introduced into his farm he is now wellknown all over the district as a progressive agriculturist. It may be incidentally mentioned that Mr. Pandit was once a member of the C. P. Agricultural Department before he took up the legal profession, and the keen interest he now envinces in improved agriculture is perhaps a legacy of that connection.

Mr. Pandit's farm consists of about 80 acres of land and is situated on the banks of the river Wainganga. The river being at a very low level does not serve any useful purpose to the farm; but it certainly adds to its beauty.

The farm was started in the year 1920 and ever since has made steady progress in the cultivation of various kinds of crops under the able management of the proprietors, the Pandit brothers, and their manager Mr. N. R. Hardiker.

The crops grown are many, but our interest is focussed at the sugar cane plantation which consists of an area of about 20 acres, and it is the main source of income to the farm.

The soil of the cane land is the ordinary *morand*, but seems to be of a heavier type. Although this is not supposed to be a very suitable soil for cane cultivation the canes seem to thrive well on it. The water supply comes from the Ramtek tank, 39 miles off from the place, and they have to pay as much as Rs. 20 per acre for it every year.

As regards the preparation of the soil, the farm follows the local method. The practice of growing paddy before cane as in Java, is prevalent here. After paddy the land is fallowed for a year and then night soil is applied by the shallow-trench method in January. The use of night soil minimises the expenses of manuring to a great extent and at the same time gives the maximum possible fertility to the soil so much so that the land does not require any manuring even for the three successive ratoon crops. The price of a cartload of night soil containing 500 lbs. is As. 12 including expenses of spreading in trenches and covering with earth. Thus the expenses for manuring an acre of land with 100 carts of night soil comes up to a very insignificant amount. After the lapse of 3 years a dose of 225 lbs. of Ammonium sulphate and 500 lbs. of *til* cake is applied to the ratoon crop which is preserved for another 2 to 3 years. After the usual ploughings by the ordinary ploughs and *bakhars* the setts are planted in trenches according to the Java method leaving wide intervening spaces of 1½ feet in the shape of ridges which afterwards are converted to trenches again as the plants grow in height, for facilitating weeding and interculture.

The method of trench-planting has many advantages over the indigenous method of planting. In trench-planting the roots are allowed to spread much below the surface soil and therefore are not affected by the cracking of the soil. A well developed root system gives rise to a vigorous and healthy plant. Besides the system of trench-planting saves labour, as well as setts and ensures germination and therefore is better than surface planting which

although aids easy sprouting requires a larger number of setts due to uncertainty of germination.

The farm formerly used to plant Co. 219 but as it did not give the desired effect in yield and ratooning they have taken to Co. 210, which is giving very satisfactory results. Tops are supposed to be better for planting as it is quick in sprouting but as the water supply is not continuous they have to plant whloe-cane setts.

Earthing up is generally done in the farm to give the plant a strong footing and to prevent lodging. Moreover by earthing up the lateral roots develop and profuse tillering is also induced. Tying and propping is also practised in the farm and although it involves heavy expenditure it insures against the falling down and lodging of the plants resulting in sour juice and inferior *gur*.

A catch crop of onions is taken from sugar-cane lands. This matures in about 3 month and gives a fairly good yield, as much as 40 mds. per acre. This gives about Rs. 60 per acre and reduces the cost of cane cultivation.

One peculiarity of cane cultivation in this farm is that the ratoon crop is preserved for more than 5 years, sometimes the period extending to 7 or 8 years. This reduces the cost of cultivation and increases profits. Agricultural departments in India do not advocate ratooning lest diseases might spread and canes deteriorate in quality. There is no reason why ratooning should be harmful in India when it is widely practised in every other country and the experience of this farm shows that it can be successfully done. It has recently been shown that setts from ratoons give an excellent crop.

For crushing cane the farm uses a Blackstone oil engine of 10 H. P. with "*chittanooga*" cane crusher fitted with automatic arrangements for pumping juice to the reservoir from where it is taken by pipes to the different pans over the furnaces at the time of *gur* making. The initial cost of such a plant is about Rs. 2000 to Rs. 2500. This plant has a capacity of extracting 120 gallons of juice per hour. The cost of working the plant amounts to about Rs. 2 per day of 10.

The furnace used for *gur* making is the Sindewahi or "McGlashan" furnace and the management is of opinion that it is very economic and efficient.

The net profit of the farm before the depression used to be Rs. 4000 to Rs. 5000 a year, the main revenue coming from the sale of *gur*. The cane plantation of 20 acres brought for them a net profit of about Rs. 2500 a year. This shows how very profitable sugarcane cultivation is.

Recently they have purchased a " Sugar centrifugal " for preparing crude sugar from *Rab*. The machine costs about Rs. 600 and the process is easy. The *rab* is preserved for 10 to 15 days for crystallisation and is then subjected to centrifugal force for about 20 minutes which separates the crystalls from the molasses. A sample of the sugar so prepared was given to us and we found it very attractive.

We take this opportunity to thank Messrs Pandit brothers and their manager Mr. Hardikar for their kindness in showing us round their farm and for the trouble they have taken to make our short stay in their farm interesting and instructive.

The Mango*

BY N. K. DAS, L. AG.

The mango has been known in India from time immemorial. Mention has been made of it in ancient Sanskrit literature as well as in the writings of foreign travellers who visited India during the Buddhistic period. Abbul Fazl says in his *Ain-i-Akhbari* that there were many varieties of the mango under cultivation in India during his time. Today hundreds of varieties can be found in this country and many of them are of excellent quality. Recently, Indian mangoes were being sold in London and secured good prices. This shows that an overseas trade in mangoes can probably be developed.

The mango is essentially a fruit of the tropics; but it grows in all tropical and subtropical climates all over the world. It is found in most of the provinces of India but certain parts of the country appear to be more congenial to it than others.

Soil.—The mango will do well almost on any type of high-lying soil except those that are very light and porous. Sandy soils are not firm enough to support such a huge tree. It is essential that the soil should be deep, well drained and well supplied with lime. Speaking generally, acid soils are not suitable for the cultivation of fruit trees. The presence of about five per cent lime in the soil is considered desirable for the cultivation of high class mangoes. If there is a deficiency of this ingredient it should be made good by the addition of lime to the soil. In selecting the site for a mango orchard

* The writer is indebted to Bulletin No. 103 of the Department of Agriculture, Bombay (1920) and to "A Treatise on Mango" by P. C. De, for some information contained in this article.

the character of the sub-stratum should also be taken into consideration. The mango is of a deep-rooting habit and a hard or rocky sub-stratum will therefore interfere with the penetration of its roots. A deep layer of exceedingly porous texture below the top soil should also be avoided. Such a layer will fail to supply sufficient moisture to the trees during the dry season.

Climate.—No success can be achieved with the mango in very cold climates and frost will do it positive harm. For this reason no mango trees are to be seen at Shillong—though they are to be found in the plains of Assam. The maximum temperature that the mango will stand cannot be laid down with certainty. A mean temperature of 75 to 80 degrees of F is said to be particularly favourable for its active growth. *

A humid climate throughout the year is not congenial to the mango. For this reason, high class mangoes do not do so well in Assam and lower Bengal whereas in the Bombay Presidency, the United Provinces Bihar and the comparatively drier districts of Bengal excellent mangoes can be produced. Rain and fog at the flowering time hinder pollination and cause a large proportion of the flowers to drop off without setting fruits. For profuse bearing and high quality of fruit those provinces which have a fairly abundant rain-fall distributed from June to September are particularly favourable.

Propagation.—The mango is generally propagated by grafting scions of desired varieties on to the stocks of hardy races. In horticultural practice the seed is not used for propagation, since there is no certainty that the seedling all come true to type. Inarching is the best method of propagation. This consists in joining the cut surface of a branch of the tree which is desired to propagate with the cut surface of the stem of a seedling tree so as to cause their permanent union.

The best time for grafting in general is when the mango is in flush. Inarching can however be done almost at any time of the year.

Site for planting.—The site selected should be well-drained. Grown-up mango trees can withstand water-logging to a certain extent but not the young trees. In places of uncertain or scanty rainfall the source of water supply should be taken into consideration, since an orchard in such localities will require irrigation for the first few years, the actual period depending upon the condition of the soil and the climate.

Preparation of land.—After the site has been selected the land should be cleared of all trees and stumps and the scrubby growth burnt on the spot. The

* See Bulletin No. 103 of the Department of Agriculture, Bombay, 1920.

ashes should be either preserved for putting into the pits for planting the trees or incorporated into the soil by cultivation. The land should then be levelled, allowing a gentle slope for leading irrigation water, and divided into blocks, if necessary. If the size of the orchard demands, roads and pathways should also be laid out.

Planting :—When the land is ready the spots where the trees are to be planted should be marked out with stakes. These should be ten yards apart each way. It would be a mistake to plant mango trees closer than this. The land in between the roads may be utilized for growing catch crops. Pits 3' × 3' × 3' should be dug at the spots marked out as soon as the land is ready. The earth taken out should be mixed with manures and put back into the pits, a few days before planting. The following manure is recommended for each pit by the Department of Agriculture, Bombay as a preliminary doze.

Well-rotted farmyard manure ...		...	1 cwt.
Bone meal	...	... ...	5 lbs.
Wood ashes	...	... ...	10 lbs.

Ordinarily, the best time for planting mango trees would be the beginning of the rainy season. If however the rainfall is very heavy and there is any likelihood of the young plants suffering from water-logging, it would be preferable to plant them towards the end of the rainy season.

In planting an orchard it is advisable to use grafts made on young stocks. Such grafts can be expected to commence regular growth earlier than those that have grown too long in pots. There is always some probability of the roots of the latter becoming pot-bound. At the time of planting, each plant with the whole lump of soil should be carefully taken out of the pot and planted at the centre of the pit so that the lump of soil may just sink below the ground level. The soil round about the plant should then be tramped firmly and moistened with water.

Manuring :—Leaf mould, well rotted cowdung, jungle scrapings, wood ashes, bonemeal, etc., may be used. The quantity to be applied depends upon the age of the tree as well as the character of the soil. The recommendations of the Department of Agriculture, Bombay are as follows—For a one-year-old tree the dressing recommended consists of 20 lbs farm yard manure, 5 lbs bone meal and 10 lbs wood ash. Subsequently the quantity of farmyard manure is increased by 10 lbs per year upto 100 lbs ; of bonemeal by 1 lb upto 15 lbs and of wood ashes by 2 lbs upto 30 lbs. These manures are best applied at the beginning of the rains in circular trenches six inches deep and sufficiently wide, made around the bases of the trees. Manures should always be covered or mixed up with the soil and not allowed to lie on the surface.

When no catch crops are grown in the orchard green manuring can be adopted with advantage. This will minimise the requirements of farmyard manure.

Irrigation :—In the absence of rain mango trees will have to be watered about twice a week for some time. When the plants have become established the interval between successive waterings may be lengthened gradually and still later, water should be applied only when the condition of the soil, the plants, and the season demand it. In places of heavy rainfall, artificial irrigation is scarcely necessary. In other tracts, irrigation is not required for more than four or five years except in very dry regions where it may be necessary for a longer period.

In horticulture, it is often considered desirable to irrigate fruit trees when they are in flower and also when they are maturing their fruits. This practice may be adopted in the case of the mango also but irrigation should be discontinued as soon as the fruits have attained their full size.

Soluble artificial fertilizers can be profitably applied during the dry season only. When these are used irrigation is necessary to make them available to the trees.

Prunning :—In order to obtain well shaped trees a certain amount of care in the way of prunning will have to be given to the grafts during the first few years after planting. The best results can be obtained only when well-made grafts have been used for planting. Side branches too near the ground should not be allowed to develop. Such branches interfere with inter-cultivation. The rest of the branches should be kept well spaced and well balanced. Any of the side-branches found to out grow the others should be headed back so that all of them may develop equally on all sides. The secondary and other branches produced in course of time should be treated in the same manner. If the tree shows any tendency to grow upward only, without producing any side branches, the top should be pinched off. This will encourage the development of side branches. If a little trouble is taken for prunning the trees during the first few years, little or no prunning will be required later on except the occasional cutting off of dead and dying branches.

Compound crotches (many branches arising from the same point) are very objectionable in a huge tree like the mango. When high winds blow through heavily laden mango trees possessing compound crotches, they split and damage the trees.

Flowering and fruiting :—The flowering time of the mango is round about the month of January though at other times of the year also it is some-

times observed. The flowers are generally fertilized through the medium of insects but self-pollination is also possible.

The grafted mango tree, under good management, begins to bear fruits in its fourth or fifth year, the crop of the first bearing season consisting of a few fruits only. Within the next five or six years the annual crop may increase to several hundred fruits.

Harvesting :—In harvesting mangoes for the market one cannot be too careful. Bruised fruits cannot be stored for a long time and such fruits deteriorate quickly in transit. It is a bad practice to harvest mangoes by shaking the branches of the trees. A long bamboo pole the top of which is split up and woven into a miniature bowl-shaped basket is sometimes used with advantage. The use of a harvesting net fixed at the end of a long pole would be preferable.

Mangoes for trade purposes have to be picked sometime before they are ripe. But precaution has to be taken not to pick them too early, in which case they will not properly develop the characteristic taste and flavour of the fully mature fruits. Even when mangoes are required for home consumption they should not be allowed to become quite ripe on the tree. Birds and bats destroy such fruits.

Ripening :—After picking, the fruits should be removed to a store house, dry, well ventilated and provided with platforms. A layer of dry straw may be spread on the platforms to serve as a sort of cushion. The fruits should then be sorted and spread in a single layer on the straw and allowed to ripen. If quick ripening is desired another layer of straw should be spread over the fruits. The ripening of mangoes can also be effected by storing them in unhusked rice. But this method can be adopted only when a small number of fruits has to be dealt with.

Packing :—In packing mangoes for distant markets care should be taken to make the package well ventilated. In the absence of ventilation the fruits ripen quickly on the way and may get spoiled before reaching their destination. Heavy packages are generally handled very roughly by coolies at the time of transhipment and such packages are likely to give way. Hence it is desirable to avoid putting too many mangoes in a single package. It would be worth-while to wrap mangoes of good varieties individually in soft tissue paper and pack them in soft dry grass.

Irregular bearing :—A peculiarity of the mango tree is that it yields a normal crop generally in alternate years only. It is not possible to give any definite reason for this. Systematic manuring may improve matters and thinning of flowers and fruits may also be tried. But whether any or all of

these precautions will break the tree of its habit of irregular bearing, one can hardly say with certainty.

Rain and fog during the flowering time unfavourably affect the bearing of the mango. These prevent the setting of fruits. Young fruits are sometimes caused to drop in large numbers by hot winds which dry up their delicate stalks. To protect the fruits against such winds sprinkling water on the trees has been recommended.

Varieties.—There are many varieties of the mango to be found in India. Pairi, Alphonso, Mulgoba, Batli, Lengra, Fazli, Malda and Kissenbhog are some of the best varieties to be found in different parts of the country. Fruits of all these varieties do not keep equally well. In growing mangoes for distant markets only those varieties that keep well should be selected. Alphonso, Fernandin, Sakharia, Borsha, Batli and Khoout of the Bombay Presidency are said to keep well.

Uses of the mango :—The pulp of the ripe mango is used as food. Green mangoes are used for making pickles and certain culinary preparations. The juice and pulp of the mango may also be canned and preserved for future use. The flowers, when taken internally, are said to cure physical and mental ailments. At the time of worshipping the goddess Saraswati (the goddess of learning and music), the worshipper eats mango flowers sprinkled with sandal paste and utters the following mantra—

"*Chutapushpam basantadau*
bhakshyami sachandanam,
Roga-shoka-binashaya,
sukh, kalayan hetave"

"At the advent of spring I eat the mango inflorescence (besmeared) with sandal (paste) for the destruction of all physical and mental ailments and for bringing happiness and prosperity."

OBITUARY

We have to intimate with deep sorrow the death of one of our first year students, **Mr. Yakub Hussain.** The following resolution was passed in a meeting of the students and staff of the college.

"We the students and staff of the College of Agriculture Nagpur, deeply regret the premature death of Mr. Yakub Hussain. May his soul rest in peace!

We wish to express our heart felt sympathy with the bereaved family."

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Editorial Notes

CHRISTIAN MISSIONS AND INDIAN AGRICULTURE

THE contribution of the Christian Missions in India in the direction of education, medical relief and social uplift is well known to all and has undoubtedly been a potent factor in the awakening of the masses. Agricultural work, however, is a new line of activity recently taken up by certain missions that consider work for the improvement of agriculture and village life as an integral part of missionary enterprise. The Agricultural missionary seeks to bring fullness of life to those with whom he works, and helping them to do better farming and better business is one of the ways of accomplishing his ideal. Dr. Butterfield's visit to India in 1930 and the excellent report he prepared on the rural reconstruction work of the missions gave a great stimulus to the agricultural work, particularly of the Protestant missions. The rural reconstruction centres at Marthandom and Ramanathapuram have attracted the attention of the whole of India. The mission agricultural schools at Katpadi, Sangli and other places and the Agricultural Institute at Allahabad have been trying to train up the right type of men required for leadership in rural India. At several mission centres all over India, the missionaries are running experimental and demonstration farms for popularising modern scientific methods of agriculture amongst the rural population. A certain section of the people—missionaries and laymen who support the mission with funds—do not however, view this aspect of mission work with much favour and

would restrict mission activity to spiritual work. In this connection the recommendation of the Commission appointed by the Laymen's Foreign Mission Enquiry to study missions in the Far East and to make recommendations concerning their future, are of considerable interest to all concerned in the development of rural India. Instead of curtailing "the agricultural work of the missionaries is to be put on a more comprehensive basis"; and "the agricultural worker is to go hand in hand with the physician, the nurse, the school teacher and minister to help all who are in need without regard to religion or caste." With regard to the character of the work the Commission has recommended that the attention of the mission should be given the following three lines of endeavour.

(*a*) "The development of agricultural middle schools in rural environments devoted primarily to the training of agricultural and country life leaders."

(*b*) "To experimentation in the development of co-ordinated rural service in which the leader of the project gives special attention to organizing the people of the rural area to make use of the agricultural extension services, the public health and medical services, the educational services and the religious influences which are already available or which may be provided in improving the quality of the life of all the people in the village or group of villages which may be enlisted in this common undertaking."

(*c*) Stimulating "the further development of basic research in economic and social problems relating to agricultural and rural life."

The Commission has also pointed out the need for a country life movement "to bring together all workers connected with rural life to stimulate an intelligent interest on the part of all and to develop the spirit of service in those who administer rural affairs." For the purpose of stimulating this movement the

Commission has suggested the organisation of "an international committee to promote a world congress of Country Life Workers to be held eighteen months or two years hence."

Considering the great zeal and driving power which the missionaries carry in all their undertakings these recommendations of the Commission have far reaching consequences for Indian agriculture. By virtue of his training and way of life the missionary has a peculiar appeal to the village folks and is a unique medium for carrying new ideas into the highly conservative rural regions of India. He will be a great asset to the existing organisations for extension and propaganda work in rural areas and his participation in the work of reconstructing rural India will undoubtedly hasten the pace of that Herculean task.

THE PROBLEM OF THE LANTANA.

The problem of protecting agricultural lands from being overrun by pests and rendered unfit for the growth of crops is assuming serious diamensions in India. Stretches of excellent paddy and jute lands in Bengal have been thrown out of cultivation by the incursions of water Hayacinth. Large areas in Southern India and the Deccan plateau have been invaded by the pernicious prickly pear which was once considered a useful hedge plant by the land owners but is now a very dangerous pest inflicting incalculable harm on the poor cultivators. So is *lantana* a small shrub introduced into India as an ornamental hedge plant about a century ago. In the march issue of "Current Science" Mr. A. V. Varadaraja Iyengar contributes a very interesting article on the menace of the *lantana* and urges the need for a quick and cheap method of controlling its spread. *Lantana* is a highly tenacious shrub. It can withstand drought and is capable of coming up again after being cut, trampled or even burnt by fire. During recent years the spread of *lantana* has been enormous and rapid; for example in four forest ranges in north Salem,

Madras Presidency, the area under *lantana* has increased from about 3 to 42 percent of the total forest lands within a short period of fourteen years. *Lantana* is a very dangerous pest in forests as it burns readily even when green and thus facilitates the spread of forest fires. It is also equally dangerous to agricultural and grazing lands. Several attempts were made in south India to check the spread of this weed but with no appreciable success. The possibility of controlling *lantana* by insect parasites was investigated in 1916 by a special officer who recommended the introduction of a *agromyzid* fly which was reported effectively to control *lantana* in Hawaii Islands. But it was feared that the fly would prove a pest on some of the useful species of the same order. Nevertheless some experiments in this direction were conducted in Mysore and it was found that the *agromyzid* fly did not take to *lantana* very kindly. No attempt has so far been made to control *lantana* by cultural methods. It appears that *lantana* does not thrive on soils which contain a high percentage of Kaolin or certain other light silicious earth. Again *lantana* does not thrive under dense cover, and heavy foliage species of the high forest type generally pervents the inroads of this pest. These undoubtedly indicate fruitful lines of research. The use of chemicals is another promising field. In this connection a note on the use of sodium chlorate as a weedicide which appears on another page may be found interesting.

WORLD'S GRAIN EXHIBITION AND CONFERENCE.

The World's grain exhibition and conference which was planned to be held in Canada in the summer of 1932 has finally been arranged to take place during July—August 1933 at Regina, Saskatchewan, Canada. The object is to bring together world authorities on Agriculture, particularly those interested in field crops, and further to bring into open competition grain and other seed produced in different parts of the world. In such an

event as a world's grain exhibition and conference there are wonderful possibilities for stimulating interest in the improving of the quality of cereal crops and in the disseminating of knowledge of how to improve agricultural conditions generally. The Canadian Federal Government has invited all countries to participate. Approximately 200,000 dollars will be given away in prizes. Most countries of Europe and America are participating in the exhibition and conference by sending delegates of experts and also exhibits. The Imperial Council of Agricultural Research is making arrangements to collect and despatch samples of grain produced in India. It is gratifying to note that our Province also will be represented in this mighty show. A few research papers concerning grain production, some samples of grain and a few photographs illustrating marketing operations have been supplied by this Province.

HYDRO-ELECTRIC DEVELOPMENT IN MADRAS.

The Pykara Hydro-Electric system which was recently opened by His Excellency the Governor of Madras constitutes a landmark in the industrial and agricultural development of the Madras Presidency. What has now been inaugurated is only the first stage of a mammoth scheme capable of developing 120,000 horse-power. At present only 33,000 horse-power is installed 11,000 of which is to be used as a stand by or emergency. The chief features of the project are the diversion dam across the Pykara river near the falls in Coimbatore, the flume seven thousand feet long, the forebay near the edge of the plateau which together with the Glenmorgan Reservoir provide a total storage of 84 million cubic feet of water, the penstock pipes down the hill over ten thousand feet long and the power house at the foot. A gross head of 3,080 feet is obtained in this process and this is stated to be one of the highest in the world. The total cost of the scheme has been a crore and quarter rupees. The economy of the scheme can be appreciated when it is realised that only

about 300 cusecs of water are necessary to produce this 120,000 horse power. Three districts, eight towns and three villages are being supplied with an electric light and power service while industrial plants amounting to between 5000 and 6000 horse power are to be electrified this year and additional load is expected the following year. The importance of the scheme in the industrial development of Madras can be realised only when one remembers the fact that the province has to import every ounce of its coal and oil. In his opening speech His Excellency emphasised the agricultural aspect of the undertaking "'Any one who has travelled on a long journey through Europe'" said he "must have been impressed by the immense development in the spread of electricity in the last 20 years. In many parts every tiny village has its electrical supply, and lights wink at one from the most isolated farmstead. Throughout the world the peasant is notoriously conservative in his ideas and in many places educationally little more advanced than our Madras *ryot*. Captious critics, I am sure, scoffed at the idea that a peasantry could be persuaded to realise the value of electricity, yet in a very short period the seeming impossibility has come to pass. Is it too much to hope that in time the Madras *ryot* will be similarly converted to the advantages of electricity as a power unit where power is required and that in the villages the clean electric bulb supplied with power from our abundant streams will replace the smelly oil-lamp burning a fuel which has been transported thousands of miles? Prejudice at first there no doubt will be, but I am decidedly not one of those who think such a vision incapable of fulfilment.'"

THE LATE Dr. C. A. BARBER.

Dr. C. A. Barber whose sad death took place recently in England was a pioneer in Agricultural work in India. The name of Dr. Barber brings to mind the numerous varieties of Coimbatore canes that have now attained international reputa-

tion. Dr. Barber came to India in 1898 as Government Botanist, Madras and Director of Botanical Survey in South India. He soon turned his attention to the study of Economic Botany, and was instrumental in establishing several Government Experimental farms for the improvement of the important crops of the Province. In 1912 he was appointed as Sugarcane Expert to the Government of India and the excellent work he has done in this capacity is embodied in the several valuable papers he has published and their economic value is now well known to all agriculturists in India. It was only recently that he was awarded the Maynard-Gangaram prize for his work on sugarcane. The Madras Department of Agriculture owes a great deal of its present efficiency to the valuable pioneering work done by Dr. Barber in the early days. Steps are being taken by his admirers and colleagues in Madras to perpetuate his memory in a suitable manner.

Original Articles

RURAL SOCIAL CHANGE AND RURAL EDUCATION IN AMERICA *

BY J. L. HYPES PH. D.

(Storrs, Conn. U. S. A.)

Introduction.—Rural life in America is very dynamic. Perhaps, as in no other country in the modern world, it has experienced, in recent decades, such startling changes as to arouse both admiration and fear.

It is altogether fitting and proper that educational leaders should take critical note of these changes in order that they may see more clearly their professional responsibilities, for if education is to take its rightful place as a creative and an ameliorative agency in public affairs, social change needs to be thoroughly understood and educational programs critically examined.

In attempting a discussion of rural social change with respect to its

* A paper read before the National Education Association, Washington, D.C., 1932.

significance to rural education, it is clear that the subject is too large and too complex for a full treatment at this time. So, in a spirit of humility, we shall be content to limit our effort to the following major topics:

(i) Changes in the economic base of rural life
(ii) Changes in the rural population
(iii) Changes in rural social structures and culture
(iv) Social changes and rural education

I.—Changes in the Economic Base of Rural Life.

Since public education and other forms of social service enjoyed in this country have an economic base essential to their existence, we may, with profit, examine some recent changes in the economic conditions of rural life. Let us then make a brief analysis of land utilization and rural standards of living.

The Number and Size of Farms.—While farms and farm products are not the only property subject to taxation for the support of rural institutions, they do form a very good index to the ability of rural people to maintain adequate institutional service.

TABLE 1.—*Distribution of farms according to size* (in 1,000)*

Census periods.	Total number.	Under 20 acres.	20 to 49 acres.	50 to 99 acres.	100 to 174 acres.	175 to 259 acres.	260 to 499 acres.	500 to 999 acres.	1000 acres and over.
1900 ...	5737	673	1257	1366	1422	490	377	102	47
1910 ...	6361	839	1414	1438	1516	534	443	125	50
1920 ...	6448	796	1503	1474	1449	530	475	149	67
1930 ...	6288	918	1440	1374	1342	520	451	159	80

By recourse to the Census reports, we find a number of facts of importance to the present consideration. In the first place, it is to be noted that since 1920 the number of farms in the United States has decreased about 160,000, and this decrease has occurred chiefly in the middle-sized farms. The apparent increase in the number of very small farms is really spacious, for there has been, in recent years, a back-to-the-land movement in metropolitan areas resulting in the purchase of small

* U. S. Statis. Abst., 1931.

tracts mostly for recreational and residential purposes. Many of these small tracts are devoted to recreational agriculture to the point of being classified as farms by the United States Department of Agriculture, but however socially desirable this back-to-the-land movement may be, it is a serious question whether a vast number of these small holdings should be designated as farms. On the other hand, perhaps largely as a result of big machine farming, and other economic factors, there has been a significant increase in the larger farms of 500 acres and over.

TABLE 2.—*Distribution, by Percentage of Acres, of Farm Land According to size of Farm.**

Census periods.	Under 20 acres.	20 to 49 acres.	50 to 99 acres.	100 to 174 acres.	175 to 499 acres.	500 to 999 acres.	1000 acres and over.	Total.
1910 ...	1·0	5·2	11·7	23·4	30·2	9·5	19·0	99·0
1920 ...	0·9	5·1	11·1	20·4	29·0	10·6	23·1	99·3
1930 ...	1·0	4·7	10·0	18·3	27·0	11·0	28·0	99·0

Farm Size and Farm Acreage.—These changes in the number of farms become yet more meaningful when we note the amount of land involved in the different size-class of farms. Table 2 shows that when the acreage of farm land is analyzed according to size of farms, the proportion of land in farms under twenty acres in size, over a period of years, has remained rather constant at about one per cent. However, all the groups of middle-sized farms have not only decreased in numbers during the past decade, but also in the percentage of the entire farm acreage contained in them, as well. The most significant acreage increase has occurred, however, in farms of the size of 500 acres and over. While the percentage of farms of this size is only slightly over three per cent of all the farms of the country, the acreage involved actually comprises nearly forty per cent of the land used for farming.

Parallel with this movement in land holding is the equally important trend in farm tenancy. Farm tenancy has increased steadily until it now includes forty-two per cent of all the farms of the country, and in many of our best agricultural states half or more of the farms are in the hands

* U. S. Statis. Abst., 1931.

of tenants. Some rural life thinkers see in these movements in land holding a menace to farm ownership widely and democratically distributed among the masses, and they fear that unless some radical change can be affected, rural America is on the road to peasantry similar to the *latifundia* of medieval Europe. On the other hand, others view these movements with complacency, if not with hope, and argue that these movements are but the normal results of the functioning of sound economic law. They maintain that efficiency in the use of land should not be penalized by sentimentality, and that it is not socially sound for the barren fig tree type of farmers to encumber the land. Evidently there is much room here for critical thinking and research.

Coupled with these changes in land holding, are equally marked changes in the amount and quality of farm commodities produced. As a result of the application of science, there has been, in recent years, much over-production of many important farm commodities. Thus, at the present time, we witness a paradox, namely, a major business depression accompanied by much distress in the midst of vast surplus stores of food and other raw material. Evidently, the economic status of farm life is not in an entirely satisfactory condition.

Changes in Rural Standards of Living.—*Pari passu* with these economic changes, there have occurred equally important changes in the rural standards of living. These include both material and non-material things. As a result, mere physical subsistance is not the most weighty matter in American rural life, for it is probable that only a small percentage of our rural people would be satisfied with such a standard of living. As to material welfare, American rural life is vastly superior to, that of many European and most Oriental countries. Consequently, our rural population, both individually and corporate, has taken suitable steps to enjoy many of the better things of life. According to the 1920 Census, our farm families possessed the following equipment: 30·7 per cent had automobiles; 2 per cent had motor trucks; 3·6 per cent had tractors; 38·7 per cent had telephones; 10 per cent had water piped into the house; and 7 per cent had gas or electric light. No doubt, when the report of the 1930 Census has been fully tabulated and published, far higher percentages in all these items will be noted and many others will be found added.

As an integral part of improved standards of living, there has accrued to the average rural family more time for leisure and cultural pursuits. It is clear that the time of pioneering and territorial expansion, fraught with

excessive toil, has virtually come to an end, so that our rural society may more and more turn its attention to things of the mind and the spirit. Not only are farmers' children attending high school and college in increasing numbers, but farm families are travelling considerably at home and abroad, attend the movies, possess radios, read the daily papers, and, withal, equip their homes with the habiliments of culture so that it is difficult to distinguish them from the homes of similar income groups in the city.

In view of these facts, it is not likely that the average farm family will willingly revert to the self-sufficient type of farming and the mode of life imposed by it. With a minor possible temporary tendency toward the self-sufficient type of farming, as a result of periodic economic depressions and other causes, we confidently look forward to the future for a greater specialization in farming, and a greater degree of intelligent adherence to economic law in farm production and marketing, and a demand by rural families for yet more expert service in every field, including education and other social and professional services. It should be recognized as one of the great opportunities of educational institutions of all kinds to anticipate the future and see to it that not only the biological and economic phases of rural life shall be seen in their large perspective, but especially that the social, the cultural, and the spiritual values of our civilization shall be made a growing and an integral part of our rural life.

II.—Changes in the Rural Population

Declining Birth-Rate.—Culture changes can be understood better in the light of population trends. An important change in American population, in recent years, is the lowered birth-rate.

TABLE 3.—*Rate of population increase (Dr. Gillette's Estimates.)**

	Urban.		*Rural.*	
	1910	1920	1910	1920
Birth-rate ...	25·2	23·2	30·4	28·2
Death-rate ...	16·4	15·6	13·5	13·0
Natural Increase ...	8·8	7·6	16·9	15·2

* Gillette, J. M. "Rural Sociology"

Dr. Gillette has estimated that in the decade ending 1910, the rural birth-rate of the United States was 30·4 per thousand population, while the birth-rate of the city was 25·2; and that in 1920 the birth-rates were 28·2 and 23·2 respectively. Dr. Gillette also estimated that in 1910 the death-rates of the country and city were respectively 13·5 and 16·4, thus making the rate of natural increase of population in the city about half that of the country. In a similar manner, he estimated the rural and urban death-rates for 1920 to be respectively 13·0 and 15·6, or practically the same as for the preceding decade. According to these figures, the birth-rates of both country and city from 1900 to 1920 have experienced a significant decline and the death-rates for both have remained almost stationary; consequently, the natural increase in both communities has declined.

Dr. P. K. Whelpton, of the Scripps Foundation, in the May 1931 issue of the American Journal of Sociology, presented an analysis of the population according to the 1930 Census. He reports a striking decline in the birth-rate of the country, as a whole, between the years 1920 to 1930, and a more striking decline in the excess of birth-rates over death-rates in the same period. He estimated that in 1930 there were 2,800,000 births, and in 1930, 2,410,000, or an actual decline of nearly 16 per cent. In like manner, he estimated the excess of births over deaths for the decade ending 1920 was 1,458,000 and for 1930, 1,020,000 or a decrease of about 31 per cent. Dr. Whelpton showed, moreover, that in 1930 the excess of birth over deaths was over eleven times as great as the net population increase from immigration. So long as our present immigration policy is maintained, the natural increase of population in the future will likely be the only very important source of population replacement, and if present trends in natural increase continue, a time may come when our population will become stationary in numbers.

Thus Dr. Louis I. Dublin, in an article in the November, 1931 Forum, estimated that if present conditions are maintained undisturbed, by the year 1970, or thereabouts, our population will become practically stationary in numbers at about 148,000,000. Even if our present facilities for the production of farm commodities should not be improved materially, we could easily support a far vaster population than we would likely have by 1970. But we must not forget that as a result of scientific discovery by the agricultural experiment stations and other research agencies throughout the country, the facilities for improving farm production are going forward by leaps and bounds. As a result, it appears that a progressively smaller per cent of our population can do successfully the

farming for the nation, and that our farming population in the future should easily have even more time for recreation and cultural pursuits. It also means that a large number of marginal farmers will have to make suitable vocational adjustments, or lower their standards of living.

Decrease of Farm Population.—Of special interest to our present consideration is the question of the relation between agriculture and population growth. In discussing this question, Dr. Whelpton points out rather dramatically, from the findings of the 1930 Census: "It appears that there is an increase in the rate of population growth as the proportion of workers in agriculture declines. Thus, the twelve states with the highest proportion of persons in agriculture had a population increase of only 10·4 per cent, while the twelve states with the lowest proportion in agriculture gained 20·1 per cent in population. . . . . A correlation coefficient based on these data would not be large, but nevertheless it is apparent that the agricultural states had less likelihood of experiencing an increase in population of 10 per cent or more than those in which manufacturing and commerce were more important".

Dr. Whelpton ascribed this tendency to the comparatively greater profitableness of business and manufacturing since the war, and to the very great increase in the efficiency of agricultural production so as to require relatively fewer agricultural workers for a given unit output. The basic psychological and economic reason for this tendency, he suggests, is that, in most lines of industry, greater efficiency has permitted price cuts, which, combined with an elastic demand, has caused a vast increase in consumption; this, in turn, called for more workers to supply the market. On the other hand, agriculture is less fortunate in this respect, since demand for most of its important products is relatively inelastic, and greatly lowered prices have had comparatively little effect in increasing consumption. Even under these conditions, however, farming has expanded considerably, which ultimately led to price declines, profit declines, and the forcing of a vast number of people off the farms. Thus, as noted in Table 4, 24·8 per cent of the population of the country in 1930 was able to farm so efficiently, as not only to feed the nation, but to produce vast surpluses of farm products to the embarrassment of the entire country. It is then not surprising that in the decade ending 1930, most of the population increase took place in the urban and industrial areas. Indiana, Illinois, Wisconsin, and the seven West North Central group of states, which comprise our best farming area, had a gain in rural population of only 70,452, while the states of Iowa and Missouri even lost

about 48.000 from rural communities. In this connection, it is well to repeat that much of the rural population increase in recent years has been a back-to-the-land movement in the metropoliten areas, the rapid increase of automobile ownership and extension of hard roads facilitating the movement.

TABLE 4.—*Farm Population, Rural and Urban (In 1,000)* *

Class.		1930 (April 1)	1920 (Jan. 1)	Per cent of Total 1930	1920
Total population	...	122,775	105,710	100·0	100·0
Farm population	...	30,447	31,614	24·8	29·9
Rural-farm	...	30,157	31,359	24·6	29·7
Urban-farm	...	290	255	0·2	0·2
Rural population	...	53,820	51,406	43·8	48·6
Rural-farm	...	30,157	31,358	24·6	29·7
Rural-nonfarm	...	23,663	20,048	19·2	18·9

Farm and Non-farm Rural Population.—By reference to Table 4, it is obvious that the rural population is made up of two major elements, farm and non-farm. The former in 1930 was approximately 30,157,000 and the latter 23,662,000. There is also a small percentage of urban farm population which, possibly, retains certain elements of the old farm village found in some countries of Europe and the Orient.

The rural non-farm population is one of the interesting phenomena of recent population movements in America. This phenomenon is emphasized, of course, in those states of a highly urban nature. For example, in the decade ending 1930, Connecticut lost about 10,000 of her rural farm population, but gained slightly over 40,000 in her rural non-farm population; and in 1930 her rural non-farm population was approximately five times as great as her rural farm population. The establishment of permanent and of part-time homes in the open country by city workers tends to enhance the value of rural real estate, introduces into the open country urban standards of living, and in other

* U. S. 1930 Census.

ways modifies the social structure and cultural aspects of rural life.

Population Selectivity According to Age and Sex.—Two of the most interesting and significant changes in the population movement are those of selectivity according to age and sex.

TABLE 5.—*Age Distribution, 1930 Census* *

Age groups.	*Per cent urban***	*Per cent rural***
Under 15	25·8	34·0
15-44	50·9	43·6
45 and over	23·2	22·3
Unknown	0·1	0·1
Total	100·0	100·0

With respect to age, Table 5 presents the major points of importance in comparing the rural and urban population. It is to be noted, for example, that a significantly greater percentage of the rural population is under fifteen years of age; in other words, 25.8 per cent of the urban population and 34.0 per cent of the rural population belong to this age group. This means that the burden of educating the youth is relatively greater in the country, since the wealth of the nation is concentrated in the cities, and this situation constitutes one of the paradoxes in our social organization. This table shows also that the age group between 15 and 44 constitutes a relatively greater percentage of the urban than of the rural population; this age group comprising 50.9 per cent of the urban and only 43.6 per cent of the rural population. It is clear that the city has a comparatively greater share of the age group that is young and able to do the productive work of the world.

TABLE 6.—*Sex Distribution, 1930 Census* *

	Per cent male	*Per cent female*	*Total*
Urban population ...	49·5	50·5	100·0
Rural Non-farm population...	51·2	48·8	100·0
Rural farm population ...	52·6	47·4	100·0

* U. S. Statis. Abst., 1931.

** Individual percentages changed to equal total of 100 per cent.

* U. S. Statis. Abst.. 1931.

As to selectivity according to the sex factor, Table 6 presents data of major interest. For example, we will note, according to the 1930 census, that the population, proceeding from the city to the open country, becomes more masculine in its composition, and contrarily, less feminine. In other words, the urban population is 49·5 per cent male; the rural non-farm population, 51·2 per cent male; and the rural farm population, 52·6 per cent male. There are, no doubt, many reasons why this interesting phenomenon exists, but it is probable that the chief reason is because there is relatively little vocational opportunity for unmarried women in the open country.

III.—Changes in Rural Social Structures and Culture

Changes in Rural Community Structure.—It seems obvious that large dynamic forces that determine the utilization of land, the shifting and selectivity of population, the standard of living, etc., would result also in other changes in the structure and the functions of rural community life. Many studies made throughout rural America in recent years indicate that such changes have actually taken place. Just as the self-sufficient type of agriculture is being replaced by a specialized commercial type of farming, so the all-sufficient and all-inclusive type of rural community is being replaced rapidly by the larger community which reaches out in many directions for the satisfaction of many highly cultivated and specialized wants. As a result, the rural population is becoming more mobile both as to residence and vocational employment, and rural dwellers are becoming more sophisticated and are demanding higher forms of service which can be satisfied only in the larger centers where specialization can be maintained. Hence, the rural locality, as a social entity, excepting for a few simple services, is giving way to the larger community of special interests that have their foci in widely extended centers. The extension of education to the masses, and the development of improved methods of transportation and communication, have accelerated this movement.

As a further practical result of dynamic movements in rural life, a spirit of impersonality is gradually replacing the old intimate primary group relationships and group controls. Thus, if a man does not like his neighbor or his community, it is relatively easy for him to seek more congenial associates somewhat farther away; if his neighbors are inclined to criticize him, he is likely to care very little, for rural public opinion is growing comparatively weak as a social control agency. This condition places a greater responsibility upon the individual with respect to his

social behavior, for indifference, selfishness, and extreme individualism, are apt to creep in. Therefore, agencies of public education should emphasize, in a practical way, the social and ethical responsibilities and relationships of community life in both its local and its wider reaches. Moreover, community organizers need to discover the general services that the rural community may logically provide itself, as well as the numerous special interests that demand the services of the expert and that have their foci in widely scattered centers.

Social Lag in the Rural Community.--Because rural society tends to maintain old customs and old social forms, in the face of the fact that the dynamics of modern life are undermining the usefulness of these customs and forms, there results a social lag which sometimes terminates in social conflict. For example, with the advent of the hard road and the automobile, the rural police system has almost etirely broken down. The country justice of the peace and constable are no match whatever for the highwaymen and the marauder. Likewise the rural township, or even the rural country in many cases, is becoming too inadequate a tax unit for the support of hard roads, health service, charitable institutions, high schools, and many other services demanded by modern rural people.

A prominent speaker in discussing the problems of local government before the Institute of Public Affairs of Virginia last summer, explained that: " No citizen of New York can live under less than four governments, Federal, State, County and City. If he lives in a town outside of a village, he is under five layers of government, Federal, State, County, Town, and School. If he lives in an incorporated village, another layer is added. If he lives in a town outside of the village, he may be in a fire, water, lighting, sewer, and sidewalk district in which case there are ten layers of government". Thus, in rural districts, obviously least able to support them, there are the most " layers " of government, and much confusion and worry result.

In further remarking upon this condition in New York State, a current writer in the New York Times remarks, that, " No wonder that the taxes on many farms exceed the farmer's income, and the area of farm land has shrunk 4,500,000 acres since 1880 " ; and another recent writer in the same paper points to the fact that in 1928, before the present depression, taxes were delinquent in more than nine million acres of land and nearly a million lots in Michigan. He goes on to state that to-day, during the depression, in nearly one-third of the area of the State of

Michigan, taxes are delinquent, and that similar forms of distress confront the rural areas of Wisconsin, Minnesota, Indiana, Illinois, Kentucky, Missouri, North Carolina, and many other states. Thus, the break-down in the function of rural government and its financial support are becoming serious national problems and call, as never before, for intelligent treatment.

In viewing the social, the economic, and the political problems growing out of a sparse population which demands fairly high standards of living, Premier Bracken of Manitoba has proposed, for the sake of economy and efficiency, that the three prairie provinces of the Dominion of Canada, Manitoba, Saskatchewan, and Alberta, be merged into a single central government. Likewise, similar proposals have been made for the townships and counties in some of our states, but, as yet, the proposition has not gotten far. Most rural people profess to fear that centralized government will become autocratic; they also maintain a fervid local patriotism and a sacrosanct attitude toward old definitions of democracy, hence, generally oppose the amalgamation of local divisions of government.

IV.—Social Changes and Rural Education

Adult Education.—Education has become an important function of the Federal Government. So far as the rural population is concerned, the Federal Government seems orginally to have been primarily interested in the economic phases of rural life, in that its first efforts were pretty largely confined to the parcelling out of land to homesteaders and to the promotion of research and education designed to improve agricultural production. More recently, through the passage of the Smith-Lever, the Smith-Hughes, the Purnell, the Kapper-Ketcham, and other Acts, it has widened its scope of service to include other forms of education, research and financing.

These efforts of the Federal Government, however, constitute but a part of a rapidly expanding movement toward adult education. Dr. E. L. Thorndike's researches in adult learning have shown conclusively that middle-aged adults can learn almost as easily as youths; and evidently, our adults, in increasing numbers, are determined to make use of their re-discovered ability to learn. Thus through extension courses promoted by many agencies, adults are pursuing seriously many forms of vocational education; and parent-teacher associations, travel-study groups, and other groups, are now busying themselves with many types of education of a cultural and a recreational nature. Evidently, society is making a place

in its thinking and its social organization for many types of education that it was once not concerned in; and this spontaneous response of society to the dynamics of a changing social order augurs well for the future of our country.

The Public School and Social Change.—In facing successfully the social pressure resulting from the dynamics of modern life, much responsibility rests upon the public schools. Thus, in his discussion of the teaching of government in the public schools, Dr. Charles H. Judd, in a recent issue of SCHOOL AND SOCIETY, has this to say: "Let me sketch in a general way the progress which I think we should try to have adopted. All persons who teach or administer schools and all citizens who support schools should be led to see clearly that the purpose of education is to give young people the fullest possible equipment of civilized methods of thinking and behavior. It should be recognized that it is only through an acceptance of these gifts of civilization that the individual can achieve in a short lifetime the goals of personal existence. The individual can make his contributions to civilization only when he has command of the best techniques of life that are contributed through racial effort". Dr. Judd further states that the public school, under his plan, would become a place of individual training of students in the arts and adjustments of civilization. He suggests, for instance, that the younger students need to learn the simple adjustment such as punctuality and the social regard for the rights of others, and that reading and counting should not be taught so much as an end in themselves as a method of using one's mind and of the introduction of the pupils to the arts of civilization. In the third and fourth grades, he suggests further that the pupils be taught why weights and measures came into existence, and why weights and measures are under the control of the Federal Government. Somewhere in the upper grades, he continues, the students should be introduced to the Bureau of Standards and other scientific branches of government in order to help them understand better human social relationships and the function of government in promoting social welfare. This is a marked departure from the traditional method in the study of government, wherein mechanics and the structures of government are stressed, and relatively little is said about the function of the government in the daily lives of people.

Sensing the demand of the times for social intelligence, many progressive school systems are giving consciously vital treatment to the social core of their program of studies. For example, the writer has in

mind a school system where a first grade is studying home life. As a medium for teaching socialized self-expression to this group, the instructor has procured a large packing box which the class is converting into a series of rooms for the home. In the same school system, another group of first graders is studying, by the project method, the North American Indians, and out of sponge rubber has created wigwams, canoes, and other physical equipment of the Indian civilization. A group of third grade pupils brought from their homes numerous articles made in Japan, and from the use of these, they began the study of the people and the geography of Japan; and a group of fourth graders made a list of the things they used in daily life and found what countries produced these things. A group of fifth graders created a chart on health showing two villages, one called Healthville and the other Lazytown. In Healthville was listed the types of food which produced health, the activities that led to good personal appearance, cleanliness, etc. Over in Lazytown appeared Mosquito Swamp, Coffee River, Tea Lake, and other things undesirable from the standpoint of health and beauty. The Students' personal appearance upon coming to school decided which of the two villages they lived in. The eighth grade in its approach to the study of local history and community civics, made a survey and a large map of the community; and the high school, besides making a similar survey, conducted a political campaign focussing it upon the conditions and the problems of the local community. Statements contained in the party platforms and campaign speeches were frequently challenged, which resulted in a very intensive use of textbooks and the library. Thus, in line with sound principles of pedagogy, the pupils were introduced to a clear understanding of social relationships and responsibilities, through a study of society itself.

Rural Teacher Preparation.—It is obvious that the instruction of our rural youth as responsible members of a complex social order should be in the hands of the expert, but the diversity of the rural teachers' tasks, the shortness of their tenure, and other factors, make it difficult for them to become experts. While great progress, no doubt, in recent years, has been made in the professional improvement of the rural teaching force, there is a question whether that improvement has occurred as rapidly as the evolution in rural life has taken place.

But rural education, particularly in its social phases, is so important that a persistent and a redoubled effort should be made to recruit into the rural teaching force men and women of good minds and sound professional training. The elementary school teachers and the teachers of social

sciences in the high schools should not only have a basic grounding in the social sciences, but in the methods of teaching them as well. Thus in order that the social subjects may become a vital force in the lives of the students and the community, the methods of teaching social subjects should be regarded as of great importance in teacher preparation. Through the development of the industrial arts, vocational education, and the project method, a good approach to improved teaching of the social subjects is suggested, but since society itself, rather than textbooks, should be the subject-matter of the social sciences, the sociological survey seems to be an exceedingly promising method of procedure. Through a mastery of the sociological survey, the prospective teacher may acquire a method of procedure which, if suitably modified for specific age-groups, may be used in teaching children from the lower grades through the high school. It will prove useful in the teaching of history, community civics, health, literature, art, and nature study—in fact, almost the whole category of subjects found in the programme of studies. Folk-lore, tales of adventure, stories of how the early settlers lived, the methods of work and play in other lands, historical episodes, population movements, standards of living, and much other valuable socio-cultural information, may be collected from the local community, for most of our communities contain people of many national origins and of many cultural interests. Drama, art, and music, are also fruitful socializing agencies, and a museum established at the school or some other convenient point, at once becomes the focus of great interest to both children and adults. All these, both as subject matter and method, should be included in the professional training of the rural teachers.

Summary

In order to summarize briefly some of the social changes taking place in American rural life and their educational significance, we shall make the following topical notations:

(1) Rural society is very dynamic, and is growing more specialized as to function, more complex and more impersonal as to social relationships, and more mobile as to the residence and the vocational employment of the people.

(2) The line of socio-cultural demarcation between the country and the city are growing dimmer. This is shown by rapidly rising standards of living in the country, the phenomenal increase in high school enrollment of rural boys and girls, the expansion of rural adult education, great progress in rural school

consolidation, the extensive travel by farmers and their families, the improved provisions for rural health and recreation, the growing demand on the part of the rural people for expert service of all kinds, the passing of rural provincialism, the breaking up of small neighborhoods, the weakening and closing of many rural churches and other socio-economic institutions.

(3) As a phase of these changes, there has been marked growth in the number of small suburban properties, a withdrawal of population from certain cut-over and sparsely settled areas, the decrease of population in many rural villages and in many of the best farming sections, the increase in size of farms in the more important livestock and cereal crop areas, greater specialization and commercialization in farming, and, withal, a marked reduction in the number of farm population both in gross numbers and percentage.

(4) As a result of these changes there has occurred a certain amount of social lag in rural America. Material development and many cultural changes have outrun certain folkways and mores. This condition is especially noted in local government which is often characterized by public indifference, official inefficiency, and burdensome tax rates. Evidently, in the name of democracy, many small units of government are being retained long after their day of usefulness has passed.

(5) The dynamic changes in American rural life, both in their beneficent and in their pathological aspects, need to be described and evaluated. This is clearly the function of scholars and researchers. But, equally important, the public at large needs to be made conscious of social changes and their relation to social welfare. This is clearly the function of educational agencies of all kinds and a special challenge to the rural schools.

(6) In closing, we wish to emphasize again that social welfare and good pedagogy call for a strong social core in our educational offerings in the public schools. We also urge that if social education is to be vital and shorn of superficiality and fadism, it must be carried out by mature, well-trained, experienced teachers. This calls for a new social emphasis in teacher-training and for an adequate professional recognition of those

teachers who by means of superior educational leadership are helping rural America to come into a nobler cultural heritage.

LAND DRAINAGE

By K. S. S. Iyer, B. E.

(Concluded from our last issue)

Laying out a drainage system.—As mentioned above, first a careful survey is made of the area to be drained. Then the system of drainage, the position of outlet, mains, sub-mains and laterals are decided upon and pegged out in the field. If the ground is uniformly sloping towards a suitable outlet any one could lay out a drainage scheme for a limited area of land without much difficulty or use of elaborate survey instruments. Where the land is undulating levels are taken along these lines at intervals of 25 or 50 feet, and where the ground is uniformly sloping at longer intervals. The levels of the main are taken from the outlet upwards and of the sub-mains and laterals from the point of their junction with the main and sub-mains respectively. Bamboo or wooden pegs are fixed at the points where levels are taken. From the field records a field book is prepared giving the level of the outlet pipe, depths of cutting along the drain lines at points where levels were taken, possible gradient or slope of the drains etc. (See specimen page showing calculations.)

The digging of the drains is done in the fair season generally after January and before March or April when the soil is easily workable. The width of the drains in practice is generally 1 foot 6 inches as less would be inconvenient for using the digging instruments, baskets etc. and more would be uneconomic and unnecessary. In special cases however, where the mains are too deep or where 2 or 3 pipe lines are placed side by side in the same trench a greater width would be found necessary. On either side of the pegs a width of 9 inches is marked out to represent the width of digging and then the pegs are shifted in line about a foot from one edge of the drain. The bed level of the drain and the depth of cutting at that point may conveniently be noted down on these pegs as this will be helpful in checking the depth of digging as the work proceeds. The preliminary digging consists in digging the drain to the minimum depth required along its entire length. The top one foot of soil is collected on one side about one foot from one edge of the drain and the rest on the other side so that when the trench is refilled after laying the pipes the

subsoil can be filled first and the top soil over it without altering the fertility of the soil. After the preliminary digging the grading of the drains is done starting from the outlet upwards. The outlet level, as already mentioned, is kept fairly above the normal maximum flood level in the *nallah*.

The use of a Levelling instrument for grading the drains is inconvenient and tedious; instead a simple contrivance called a 'GRADER' is used. (See Fig. 14.) The grader is adjusted to the desired slope on the brass plate and the bed of the trench is scraped wherever necessary till the spirit level has its bubble in the centre, thus indicating that the bed of the trench has the necessary slope along its entire length. This is done till the beds of all the drains are properly graded.

When the grading has been done the pipes are laid in the trenches from outlet upwards with their narrower ends towards the outlet, the smaller end of each pipe being well fitted into the one below. The pipe line is then straightened, as otherwise, the free flow of water would be hindered.

The minors are arranged so as to join the mains from above instead of from the sides, (see fig. 8) and also in the direction of the fall of the minor. Generally the minors are inclined at slightly less than a right angle with the main and in cases where they are exactly at a right angle they are given a slight bend about 5 to 6 feet above the point of junction with the main.

After laying the pipes and straightening them, they are covered by a layer of 2 to 3 inches coarse sand and then the soil is filled in slowly taking care that no pipe is broken or damaged and that the relative positions of subsoil and surface soil remain unaltered. It must be remembered that all the earth dug from the trench is put back on the drain line in the shape of a heap not more than 6 feet high and extending about 6 inches on either side of the edges of the trench. After a few showers this loose heap will settle down and come to the level of the surrounding land. Silt traps should be constructed wherever required. The mouth of the outlet pipe is tied with a piece of wire netting to prevent insects and reptiles getting in and blocking the pipes. When the pipes begin to run the wire netting is temporarily removed to allow a free passage for water. The area adjoining the outlet pipe is carefully protected with stone pitching to prevent the earth and thence the pipes from being washed away by erosion. In practice some difficulties often arise and in such cases suitable measures will have to be adopted. One

such would be that where the land suddenly changes from a gentle to a steep slope along the length of a minor or main. A uniform slope for the drain in such cases would take the pipe lines either too deep or too shallow in some places. In such cases a bend, if introduced, will be helpful in overcoming this difficulty. Sometimes the main may be too deep and if the minors have to join the main with a uniform slope, the former will have to be made unnecessarily deep thus increasing the cost. In such cases the minor is given the usual depth in the upper portions and at about 10 feet from the point of junction with the main it is given a steep slope and made to join the main from the top.

Cost of drainage.—The cost of any drainage scheme depends upon the spacing of the drains, the proximity of a *nallah* or other water course to carry away the outlet water, the cost of pipes, labour etc. An approximate cost data for draining one acre of land on the Nagpur College Farm, is given separately. The cost in the mofussils would be much less since the pipes can be obtained at a low cost. Carting of pipes, sand etc., can be done by the cultivator during the slack season.

On the Government Experimental Farm, Drug, a system of drainage consisting of three parallel lines about 26 feet apart and 2 feet 9 inches to 3 feet average depth was laid close to the orange garden. Though the soil is well drained it was found that due to the proximity of an irrigation channel the garden area often remained water-logged and the plants did not thrive. This drainage, it is reported, has improved the condition of the plants.

In addition to draining several acres of *kharif* land on the Nagpur College Farm, experiments have recently been undertaken to study the effect of draining *rabi* lands. Fields which remained waterlogged throughout the monsoon and which prevented timely cultivation even for *rabi* crops, have been improved by drainage and even *kharif* crops like cotton and *juar* are now being grown on some of these drained areas. Observations on the drained fields of the College Farm show that the crops on such fields have a steadier and more healthy growth, come to maturity earlier, give better yields and have a deeper root system thus resisting the effects of drought, than those in undrained areas. Further drained areas are available for cultivation earlier than undrained areas after a heavy shower.

Conclusion.—It is thus evident that draining of waterlogged areas increases the wealth and prosperity of a nation by increasing its capacity

for crop production. In India, though this is realised attempts have not yet been made to bring about improvements on these lines. This is mainly due to the poverty and ignorance of the average cultivator. It must however be realised that a time will come sooner or later when cultivation will have to be carried to less suitable lands to supply food for the rapidly increasing population of the country. It will then be necessary to undertake the reclamation of such waterlogged areas by drainage. The poverty of the average cultivator, the low prices of agricultural produce and the fragmentation of land stand in the way of cultivators undertaking such drainage schemes. In such cases the State can, with advantage, undertake the work, as in the long run, it will be benificial to the whole nation.

Specimen page showing calculations for a drainage scheme.

Distance in feet.		Ground Level.	Formation level of the bed of the drain.	Depth of cutting in feet.	Gradient or slope.	Remarks.
Main	0	4·50	6·00	**		Outlet above normal flood level.**
	12	9·15	6·10	3·05	0·8	Junction with minor 1.
	37	9·25	6·30	2·95	in	Junction with minor 2.
	62	9·46	6·50	2·96	100	Junction with minor 3.
	87	9·70	6·70	3·00		Junction with minor 4.
Minor 1	0	9·15	6·50	2·65	0·9	Junction with main 0·4 feet above formation bed.
	50	9·68	6·95	2·73	in	
	100	10·25	7·40	2·85	100	
	150	10·38	7·85	2·53		
	194	10·93	8·25	2·68		
Minor 2	0	9·25	6·70	2·55		Junction with main 0. 4 feet above Formation bed.
	50	9·69	7·10	2·59	0·8	
	100	10·26	7·50	2·76	in	
	150	10·59	7·90	2·69	100	
	190	10·97	8·22	2·75		

Statement showing approximate quantities of materials and cost per 100 feet length of Main and Minor drains.

(Rates as current on the College Farm, Nagpur.)

Items of Work.	Rate.			Per unit.	Drains 20 feet apart (Average depth of Minor 2 feet 8 inches; and of Main 3 feet 1 inch). Soil:—Heavy.								Drains 30 feet apart. Average depth of Minor 3 feet; and of Main 3 feet—5 inches.) Soil.—Light.							
					Quantity of work.	Cost.			Quantity of work	Cost.			Quantity of work.	Cost.			Quantity of work.	Cost.		
Labour.	Rs.	As.	Ps.		*Main.*	Rs.	As.	Ps.	*Minor.*	Rs.	As.	Ps.	*Main.*	Rs.	As.	Ps.	*Minor.*	Rs.	As.	Ps.
Earth digging less 6″ of total depth.	0	8	6	100 c. ft.	387½ c. ft.	2	1	0	325 c. ft.	1	11	6	437½ c. ft.	2	5	3	375 c. ft.	2	0	0
Digging bottom 6″ depth and grading.	0	10	6	,,	75 c. ft.	0	8	0	75 c. ft.	0	8	0	75 c. ft.	0	8	0	75 c. ft.	0	8	0
Laying and jointing pipes.	0	1	0	100 ft.	100 ft.	0	1	0	100 ft.	0	1	0	100 ft.	0	1	0	100 ft.	0	1	0
Sand and earth filling.	0	4	3	100 c. ft.	462½ c. ft.	1	3	9	400 c. ft.	1	1	0	512½ c. ft.	1	5	9	450 c. ft.	1	3	3
Total labour for 100 feet.						3	13	9		3	5	6		4	4	0		3	12	3
Materials.																				
Drain pipes:—Main.	30	0	0	1000	160	4	13	0	160	3	13	6	160	4	13	0	160	3	13	6
Minor.	24	0	0	,,																
Sand (excluing carting which is done by the Farm during the slack season).	0	12	0	100 c. ft.	75 c. ft.	0	9	0	50 c. ft.	0	6	0	75 c. ft.	0	9	0	50 c. ft.	0	6	0
Total materials for 100 feet.						5	6	0		4	3	6		5	6	0		4	3	6
Total cost of laying 100 feet of drain materials and labour together.						9	3	9		7	9	0		9	10	0		7	15	9
Approximately ...						9	4	0									Approx. ...	8	0	0

Statement showing approximate length of drains and cost per acre.

20 feet spacing.					30 feet spacing.				
Length of drains in feet.	Cost per 100 feet.		Cosr per acre.		Length of drains in feet.	Cost per 100 feet.		Cost per acre.	
	Rs.	As.	Rs.	As.		Rs.	As.	Rs.	As.
Main—(Allowing 20 feet extra length for position of outlet):—215.	9	4	19	14	215.	9	10	20	11
Minors :—2180.	7	9	164	14	1460.	8	—	116	13
Total cost per acre.			184	12				137	8

From the above it will be seen that the cost of draining an acre of land ranges between Rs. 184-12-0 and Rs. 137-8-0 according as the soil is heavy or light. The cost would be much less in the case of very light soils requiring drainage as the drains can be placed more than 30 feet apart.

REFERENCES TO FIGURES

Fig. 1. Minor drain pipe 9 inches long and about 3 inches diameter at the narrow end.

Fig. 2. Main drain pipe 9 inches long and about 3¾ inches diameter at the narrow end.

Fig. 3. Minor drain pipe closed at the wider end and used at the beginning of a minor drain line.

Fig. 4. Minor junction pipe used at the junction of the minor with the main.

Fig. 5. Main junction pipe.

Fig. 6. Junction pipe used when a minor joins the main at an angle and from the side instead of from top due to the nature of the surface of the ground.

Fig. 7. Special bend required to be used some times, to avoid unnecessary extra cost.

Fig. 8. Junction of minor drain with the main.

Figs. 9. to 13. Some typical drainage systems on the Nagpur Agricultural College Farm.

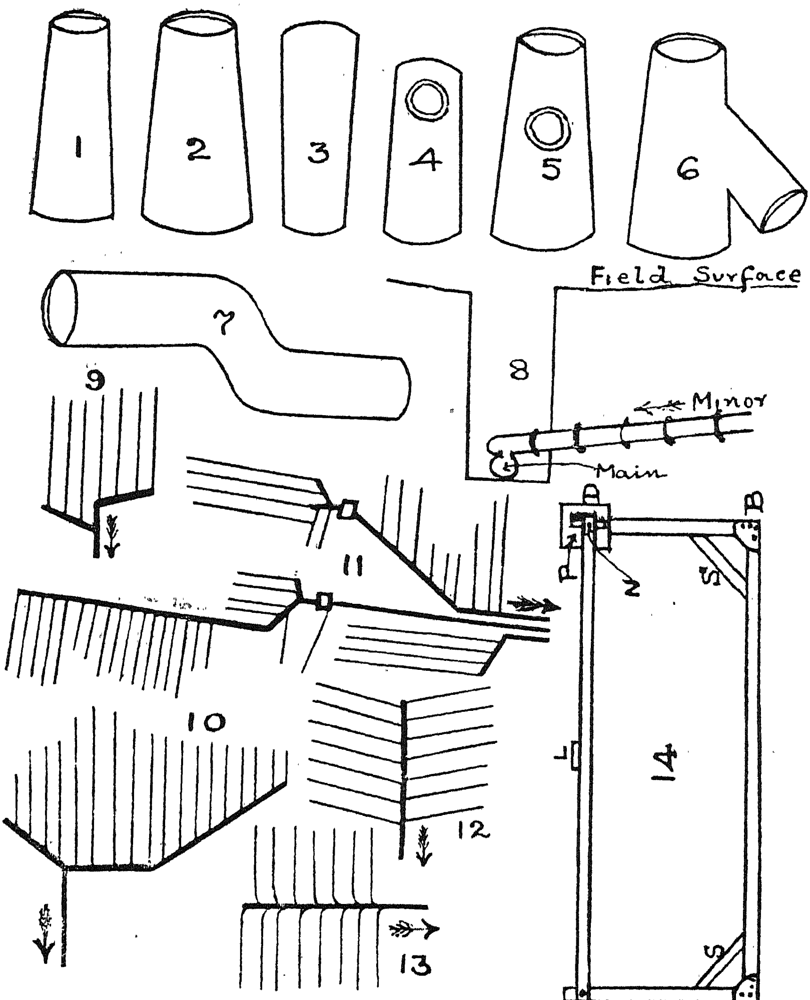

Fig. 14. The 'Grader' used for grading the bed of the drains to the necessary slope before laying the pipes. A B is a plank 2 inches × 1 inch and 10 feet long placed horizontal with A C and B D each 3 feet 6 inches × 2 inches × 1 inch fixed at right angles to it. S. S. are struts to keep A C and B D in position. C D is a plank similar to A B fixed at right angles to A C with the end D adjustable along a graduated brass plate P fixed on B D. The graduations on P are each equal to 0.01 foot. The end D is fixed in position after adjusting for the slope by the butter-fly nut N. L is a spirit level fixed at the top of C D when grading the drains. The bed of the drain, where the garder is placed after adjustment, is graded when the bubble in L stands exactly in the centre.

RELATION OF GROWTH TO FOOD-CONSUMPTION IN CALVES *

By S. K. Misra, L. Ag.

An experiment was undertaken to determine the consumption of rations by Scindi calves and to estimate the productive values of the rations employed. Two batches of calves of 6 to 8 months of age were tested in the same way. Each batch consisted of 6 calves. Three types of concentrate mixtures were fed and two calves from each batch were kept on one mixture.

As the calves were far from uniform in size and age, it was decided to feed the concentrate as accurately as possible in proportion to live weight. The rations were generally increased once a fortnight in accordance with the increase in live weight. *Sorghum* silage was used as roughage. It was fed *adlib* and the amount consumed by each animal was determined daily. Live weights were taken daily. From the daily records, weekly averages for concentrate consumption, roughage consumption and live weight for each animal were found. All the calves were uniformly given a mineral supplement of lime.

The concentrate mixtures used in the experiment, and the rates of feeding are given in table 1.

TABLE I.—*Concentrates employed in the experiment.*

Concentrate.	Composition of the mixture.	Per cent of protein.	Amount fed in lbs. per 100 lbs. live weight.	Net energy of concentrate fed per 100 lbs. live wt.
A	Wheat bran	13	1·6	1·0
B	Wheat bran 2 parts ... Groundnut cake 1 part	26	1·3	1·0
C	Broken rice, 1 part ... Groundnut cake, 1 part	31	0·9	0·8

Food consumption.—The results of the full data relating to food consumption are summarised in the accompanying table II in which also the average live weight of each animal is shown.

* This article is based on an experiment conducted by the writer while undergoing Post-graduate course at the Imperial Institute of Dairying, Bangalore.

TABLE II.—*Daily average food consumption in lbs. dry matter. Live weight in lbs.*

	Concentrate A.		Concentrate B.		Concentrate C.	
Calf No.	1	2	3	4	5	6
1st batch, averages for 84 days.						
Roughage	2·352	2·310	2·703	2·631	3·128	2·672
Concentrate	3·869	2·913	2·879	2·334	2·084	1·289
Total ...	6·221	5·223	5·582	4·965	5·212	3·961
Average live weight ...	243	178	220	185	234	166
Calf No.	7	8	9	10	11	12
2nd batch, averages for 96 days.						
Roughage	2·351	2·268	3·433	2·459	3·548	2·798
Concentrate	3·525	3·824	3·620	2·515	2·301	1·579
Total ...	5·876	6·092	7·053	4·974	5·849	4·377
Average live weight ...	216	234	275	188	254	176

Consumption of concentrate.—As it was intended to feed the concentrate in proportion to live weight, the figures in table No. 2 show a regular relationship between concentrate consumption and live weight.

Consumption of roughage.—Figures in table 2 show the relation between live weight and roughage consumption. It has to be recollected that the roughage was fed *adlib.*

Table No. 2 brings out the following points about the consumption of roughage.

(1) There is a remarkable regularity in the consumption of roughage.
(2) The roughage consumption is very closely related to the types of concentrate-feeding practised.
(3) With rations B and C there is a regular increase in roughage consumption with increasing live weight. With ration A the consumption of roughage hardly increases at all.

This shows that a high rate of concentrate feeding results in low consumption of roughage and *vice versa.*

Consumption of total dry matter.—The figures in table No. 2 show a remarkable regularity in the amount of total dry matter consumed and the regularity is closely related to the nature of the concentrate fed. It will be observed that the total consumption is greatest with ration A and least with ration C. There is also found a tendency for concentrate and roughage consumption to balance one another, but the balancing effect is not complete. A deficiency of concentrate is not quite compensated by the increase in roughage. The calves receiving least concentrate consumed least total dry matter, and the animals which were fed the highest allowance of concentrate consumed most food. It would however be noticed that the calves on C ration developed a greater capacity for roughage and tried to make a full meal even with a reduced allowance of concentrate. This is a point of practical importance.

Calculating from the figures in Table No. 2, on an average, a 210 lbs. weight calf on rations A, B and C respectively consumed 5·7, 5·5 and 4·93 lbs. of dry matter per head or 27·1, 26·2 and 23·5 lbs. per 1,000 lbs. live weight. This good consumption was entirely due to the quality of the roughage. Well made *sorghum* silage seems to be a very good fodder for calves. It is eaten with relish and the animals never get tired of it.

Increase in live weights.—The live weights of all the calves are summarized in the accompanying table III.

TABLE III.—*Increase in live weights (figures in lbs).*

	Ration A.		Ration B.		Ration C.	
Calf No.	1	2	3	4	5	6
1st batch:—						
Average live weight 12th week	296·0	220·4	265·8	227·0	276·0	195·8
Do. 1st week	190·4	134·9	174·0	142·9	191·6	137·1
Increase in 11 weeks ...	105·6	85·5	91·8	84·1	84·4	58·7
Do. per day ...	1·371	1·110	1·182	1·092	1·096	0·762
Average live weight for whole period	243·2	177·6	219·9	184·9	233·8	166·4

	Ration A.		Ration B.		Ration C.	
Calf No.	7	8	9	10	11	12
2nd batch:—						
Average live weight, 14th week	268·4	293·0	335·1	236·3	298·3	210·7
Do. 1st week ...	162·6	174·9	214·6	140·0	209·1	140·3
Increase in 13 weeks ...	105·8	118·1	120·5	96·3	89·2	70·4
Do. per day ...	1·163	1·298	1·324	1·058	0·980	0·773
Average live weight for whole period	215·5	233·9	274·8	188·1	253·7	175·5

The daily live weight increase has been calculated from the initial and final weekly averages.

The figures bring out the following points.

(*a*) The larger animals tend to grow more rapidly than the smaller ones. It may be concluded that generally this will be the result, when concentrate is fed in proportion to live weight. It should be noted however, that with rations B and C the roughage consumption increased quite as rapidly as the concentrate. It would appear therefore, that animals at this early age, naturally tend to accelerate their rate of growth.

(*b*) The live weight increase depends upon the nature of the ration. The results with ration C are decidedly the lowest and on the whole, ration A produced somewhat greater growth than ration B.

(*c*) Generally, a remarkably high rate of growth was obtained. Only 3 animals increased less than a pound a day and these three were on ration C. All the animals on ration A and B increased more than a pound a day.

There is no doubt about the high rate of increase, but it varies according to the live weight as already pointed out, hence we can only specify a rate of increase for a definite live weight. The best procedure is to calculate the mean rate of increase and apply it to the average live weight. In this way, it would be found that 210 lbs. animals on rations

A, B and C increased by 1·20, 1·12 and 0·91 lbs. a day respectively. Turning back for a moment to the food consumption data, it will be seen that the same 210 lbs. animals consumed 5·7, 5·50 and 4·93 lbs. dry matter respectively.

Selected Article

A YEAR IN INDIA*

By B. A. Keen

I arrived in India in October 1930, having been granted a year's leave of absence from Rothamsted. My duties were to take over the Directorship of the Imperial Institute of Agricultural Research at Pusa (Bihar) and to prepare a detailed scheme of reorganisation for agricultural research in the light of the Report of the Royal Commission on Agriculture in India. These duties necessitated extensive touring to visit the five sub-stations of Pusa and to see the nature and type of work done under the Provincial Departments of Agriculture. The tours were made in both the dry and rainy seasons and enabled me to see, in the aggregate, a good deal of the varied agriculture.

By far the greater part of the vast Indian population-one-fifth of the whole world in number-lives under rural conditions; there are over half a million villages, but only thirty towns with more than 100,000 inhabitants. No less than 90 per cent of the population is directly or indirectly engaged in some form of agricultural activity. Peasant farming predominates; the pressure of the population on the land is intense, and the standard of living is distressingly low. India has many of the characteristics of the intensive system of agriculture; holdings are small; there is abundant use of human labour, foodstuffs are grown, prepared, and consumed locally and the surplus, together with certain cash crops, are sold. But these characteristics are in reality the responsibilities of the system, and their adequate discharge demands a high level of fertility and the dovetailing of arable and animal husbandries into a "mixed" farming system. Neither of these requirements is fulfilled by the native system of agriculture; soil fertility is low (although there is no evidence that it is decreasing); the bulk of the cattle manure is used as fuel; the

* Reprinted from *Records of the Rothamsted Staff Harpenden*—February 1933.

animals are used merely for draught purposes and are not an integral part of the farming system. The factors just mentioned are more characteristic of the extensive than the intensive system of agriculture. They point at once to the tragic anomaly of Indian rural life; India is struggling to carry the supreme responsibility of the intensive system—a high density of population by the methods of extensive farming, which can only maintain, in health and reasonable comfort, a much smaller number of people.

There are many reasons for this. The monsoon type of climate dominates both the agriculture and the whole life of the greater part of the country. The amount of rainfall is uncertain and in any case, there is a period of several rainless months over most of the country during which agricultural operations are more or less at a standstill. The result is that certain boundary conditions are imposed on agricultural development; plant breeding investigations must be restricted to rapidly maturing varieties, and adequate provision for the pre-monsoon period of scarcity is difficult.

A second reason is the operation of the law of inheritance which results in a division of land into smaller and smaller units, so that one man or a joint family may hold a number of plots scattered among innumerable others. In some parts of the country, notably in the Punjab, the fragmentation of holdings has proceeded to such minute extremes as to prevent any agricultural operations. It is estimated that some five per cent of the land is not in cultivation for this reason, to which another one per cent must be added for field and plot boundaries. A loss of six per cent of cultivable land is a serious matter, and in some areas the officials have been able to consolidate the holdings and thus to counteract, for a generation or two, the main inefficiencies of the system. But the only permanent solution is a revision of the law of inheritance, and although educated native opinion recognizes the evils of the practice, it will be a long time before the mass of the people directly concerned will themselves desire its modification. It is unnecessary here to enlarge on the agricultural aspects of this inefficient system; the waste of labour at all stages; the automatic restriction to any attempt to grow different crops from one's neighbours; the impossibility of growing fodder crops for the animals in the period when all the village cattle are turned out to graze at large; the inability to keep cattle separate from the remainder of the village herd, and so on. Present day Indian agriculture is, in fact, very similar to the medieval three-field system of Western Europe.

The third and perhaps the most important reason for the present state of affairs is connected with the veneration of the cow by the Hindu. There is a taboo against killing cattle which exists side by side with what, to Western ideas, is a complete indifference to the miseries of starving and decrepit animals. (One of the few unpleasant memories of my extensive tours was a pariah in one of the Peshawar bazars. The dog was in an indescribable condition, but nobody took the least notice). The practical consequences so far as the *ryots* live-stock are concerned are wholly bad. The country is disastrously overstocked with cattle which are unable to perform even the inefficient services which the agricultural system imposes on them. Their primary use is for draught purposes and a vicious circle has been set up; the conditions for rearing efficient cattle are not good and the fertility of the cows falls off, so that they give undersized calves and hence a smaller proportion of useful bullocks; the cultivator is compelled to breed more and more cattle, hoping to get a better choice from the greater number, but this increases the pressure on the available fodder and the cows become even more impoverished. The average Indian cow gives barely enough milk to suckle her calf. Milk and milk products for human consumption come almost entirely from the buffalo. The Agricultural and Veterinary Departments have made numerous experiments with cross-bred cattle, using bulls imported from England, and have shown that the half-bred cow is suitable for dairy purposes, but attempts to carry the breeding further have been uniformly unsuccessful. By careful selection and proper feeding certain of the indigenous breeds in the herds at department farms have been raised to a level of milk production not far short of the cross-bred animal, and this is the better policy for India. It remains to be seen whether the increased milk production can be secured without at the same time lessening the efficiency of the bullock for draught, which is the primary function of Indian cattle. This experiment has been in progress for some years under the Pusa organisation, and the result will show whether a dual-purpose animal can be evolved from the indigenous breeds, or whether it will be necessary to keep separate draught and milking breeds. Obviously neither solution is practicable without a corresponding change in the practices of arable agriculture to secure adequate food for the animals. In the meantime, the studies in animal nutrition made at Pusa and by some of the Provincial Departments of Agriculture, the search for alternative supplies of coarse fodders, and the investigations on silage-making under Indian conditions are typical inquiries into means by which improved cattle can be introduced and maintained.

On the technical side of arable agriculture, perhaps the most important single requirement is an increased supply of organic manure. The *ryot* is, for good reasons, reluctant to grow any crop that cannot be utilized for human or animal food or sold for cash. Hence, green manuring has little scope at present. Leguminous crops are more hopeful, but the greatest possibility seems to be in the extended use of composts. Howard, at the Indore Institute of Plant Industry, has developed the method of composting waste and surplus vegetable material into a routine process, which can be managed by the average *ryot* after a short course of practical instruction at the "compost factory' at Indore. The process is continuous, and when one visits the "factory" material in all stages between the raw and finished product is to be seen. There seems every reason to believe that the process is capable of application, with minor modifications, to wide areas of India, and its general introduction is highly desirable.

Everyone concerned with agricultural administration knows the difficulty of bridging the gap between the research worker and the cultivator even in an educated country. In India the difficulties are accentuated. The country is so poor that the funds raised by taxation are quite inadequate to provide an effective advisory service even if the men were available, but the average Indian agricultural graduate has little interest in this phase of the subject; yet in present conditions it is much more necessary than any other activity; for, enlightened leadership by trained men is the great need of rural India.

Under the Reforms, agriculture became a "transferred" subject, and while this has undoubtedly stimulated Provincial interest in India's most important industry, it has had the unfortunate result of bringing it into the political arena. In consequence, there is a strong—but understandable demand—that all districts in a Province should have a fair share of the attentions of the Agricultural Department. But the butter has to be spread so very, very thinly that it is questionable whether it does any good. Another defect of the Reforms is that, in practice, the agricultural appointments in a given province are closed to natives of other Provinces; further, the flexibility associated with an all-India Agricultural Service has been lost to a large extent.

The Institution of an Imperial Council of Agricultural Research as a result of the recent report of the Royal Commission on Indian Agricul-

ture is, in effect, an attempt to remedy the two difficulties just mentioned. The Council is composed of representatives from the Central and Provincial Departments of Agriculture, the Universities, and other bodies interested in research and in agriculture. It has funds at its disposal for financing approved schemes of work and is therefore able, if it wishes, to devote full attention to improving some phase of agricultural activity in a given restricted district. In the second place, the full meetings at six-monthly intervals and the sub-committee meetings provide numerous opportunities for informal exchange of views. Although the Council has not long been in existence, I formed the definite opinion that it should be of great value to India. However, it is idle to pretend that any official organization, no matter how comprehensive, will have permanent value unless there is an awakening among the educated Indians themselves as to the real needs of their country. At present the ryot is imprisoned within the walls of his own agricultural system; year by year his numbers grow and the walls remain. Until each agricultural improvement is no longer followed by a proportionate increase in population; until the fragmentation of holdings is checked; and until the supreme difficulty of all—the cattle question—is resolutely tackled by the Hindus themselves; but so long will India remain an impoverished, backward country.

Extracts

MECHANISATION AND SOIL FERTILITY

(Extracted from Reports on the work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1930-31).

The systematic use of large scale machinery on the farm, called for convenience "mechanisation" is usually combined with a reduction in the number of live-stock kept, and hence causes certain modifications in the fertility relationships of the soil. Four important groups of problems are being investigated.

(*a*) Can fertility be sufficiently maintained by artificial fertilizers alone, or is it necessary to return the straw to the land in the form of manure? If the straw must be returned what is the best way of doing it?

(*b*) Is it possible to produce by any cultural process the same good effects on light land as are obtained by sheep folding?

(*c*) Green manuring.

(*d*) Fallowing.

The classical experiments at Rothamsted have shown that soil fertility can be kept at a certain moderate level by the use of artificial fertilisers alone without the use of farmyard manure. In general, however, the growth of the crop has not been enough to keep down weeds, and much expense has been entailed in cleaning. A combination of artificial fertilisers with occasional fallows, however, has proved effective in maintaining yields at low expenditure in labour but with a loss of one year in four or five. Where straw is saleable at a profit this method may be adopted. Where however straw cannot be sold, and this is the usual case—it may be converted into manure, so saving some of the fertiliser bill. This is readily accomplished where many animals are kept; the straw is simply turned into farmyard manure. The experiments show that crops obtain about 25 per cent of the nitrogen of farmyard manure, as compared with about 50 per cent of the nitrogen of artificial fertilisers. The recovery of potash is higher being about 60 per cent. But on many farms the numbers of animals are being reduced and the straw must be decomposed in some other way. Investigations into the decomposition of straw have long been in hand in the Bacteriological and Fermentation Departments; four different products can be obtained according to the organisms used and the conditions under which they act—a mixture of humic substances much like farmyard manure; pentoses; hexoses; and power gas (methane and hydrogne.)

For the farmer, however, the production of humus is the most important of these various changes and it has been studied in considerable detail. A method of converting a heap of straw into artificial farmyard manure by addition of nitrogen compounds, phosphate and calcium carbonate was worked out in these laboratories by Hutchinson and Richards, and developed as a large scale process by the Adco syndicate; it has been successfully adopted by large and increasing numbers of farmers and planters in Great Britain and the Overseas Empire.

Another method is now being studied; the decomposition of straw in the soil. In practice this would have the advantage of requiring less

handling of the straw and thus lowering the cost of growing cereal crops. The crop would be "stripped" *i. e.*, the ears cut off with as little straw as convenient, then the remaining straw ploughed in and allowed to decompose in the ground. The laboratory experiments show that the decomposition of the straw requires a warm temperature and a sufficient supply of nitrate or ammonium salts; if therefore the straw is ploughed into the ground in autumn while the soil is still warm and fairly rich in nitrates, the decomposition should be largely washed out if they were not utilised in this way. If, however, the straw is not ploughed in until late winter, when the soil is cold and much of the nitrate has been leached out, then decomposition is slower and may be disadvantageous to the crop by using up nitrates that would otherwise have increased its growth. Two sets of field experiments have been started to deal with these problems.

Green-Manuring.—This affords a simple method of manuring both heavy and light soils, and it requires no live-stock; it can be practised on completely mechanised farms. Its advantage in certain conditions has long been recognised, but of late years a number of instances has been recorded where, it proved ineffective. The most striking is at Woburn, where, over a series of years, green manuring with tares and with mustard has failed to increase yields of wheat.

There are, however undoubted successes, and investigations have been made and are still in progress to find the conditions under which green manuring is likely to give useful results. Two of the most important factors are the composition of the plants at the time of ploughing in and the time at which the ploughing is done. The process of green manuring needs to be closely adapted to the soil and the crop so as to ensure liberation of nitrate only when the plant is in a position to take it up.

SINDI PALMS AS A SOURCE OF GUR

By D. V. Bal,

Offg. Agricultural Chemist, C. P.

The possibility of producing *gur* from the juice of *sindi* palms (*Phœnix sylvestris*) was recently examined by the writer at the suggestion of a *malguzar* from the Nagpur district.

Samples of fresh *sindi* juice were collected from Somalwada during

the months of March and April 1932, trees of different ages being selected for this purpose. Results of analyses of the various juice samples and the yield of juice per day per tree was found to be as follows :—

Kind of tree	Dates of taking samples.	Average total quantity of juice collected per tree per day in c. cs. (450 c. c. = 1 lb. approx.)	Average per cent sucrose (cane sugar) in juice.	Average per cent of reducing sugar in juice. (Non-crystallisable.)
Young tree about 8 years old. ...	4-3-1932 14-3-1932	1390	5·0	3·0
Tree about 15 years old. ...	1-4-1932	2080	8·5	2·0
Old tree above 20 years old. ...	12-4-1932	2600	9·5	1·5

Although the various samples of juice contained about 8 per cent sugar, attempts to prepare *gur* from these did not meet with any success. It was considered that this may have been due to the high proportion of reducing sugars (non-crystallisable) to the sucrose present, as a result of the high temperatures prevailing during the summer months in which the samples were taken. It was therefore—decided to take fresh samples in the following cold weather and accordingly samples were taken again from Telankheri during the month of January 1933. Results of analyses of these samples together with the yields of juice per tree per day are given below :-

Kind of tree.	Dates of taking samples.	Average total quantity of juice collected per tree per day in c. cs. (450 c. c. =1 lb. approx.)	Average per cent sucrose (cane sugar) in juice.	Average per cent of reducing sugar in juice (non-crystallisable)	Per cent of gur obtained from the juice.
Young tree about 8 years old.	16-1-1933 18-1-1933	3100	10·0	2·5	11·0
Tree about 15 years old.	23-1-1933	4900	11·0	0·6	11·0
Old tree above 20 years old.	27-1-1933	4500	12·6	0·8	11·5

These results clearly show the low proportion of reducing sugar to the sucrose in the juice. From all the samples given above (except one) samples of *gur* were successfully prepared on a laboratory scale. The yield of *gur* from juice was found to be about 11 per cent. Samples will be again taken in the coming summer in order to ascertain if we get results similar to those obtained during the last year.

Results of experiments recorded above have however clearly proved the possibility of preparing *gur* from the juice of *sindi* palms during the winter months, and that well grown and old trees are preferable to young ones for this purpose.

The following points appear to be favourable for the production of *gur* from *sindi* palms:—

(1) *Sindi* palms which are not tapped for the purpose of producing toddy can be utilised for the production of *gur*.

(2) No special charges are required to be incurred on the cultivation of *sindi* palms as against sugarcane.

(3) No machinery of any kind is required for the extraction of the juice. The charges required to be incurred in tapping the juice would probably be equal to those incurred in extracting the juice from cane.

(4) It would give work to the cultivators in a season when they are not otherwise very busily engaged.

Gleanings

Sodium Chlorate as a weed killer.—Sodium Chlorate is a white crystalline salt that is readily soluble in cold water, and is, best applied in solution in the form of a spray. The effective strength of the solution will vary with different weeds and their stage of growth. For most weeds, particularly deep-rooting ones, a 10 per cent solution is required, prepared by dissolving the sodium chlorate at the rate of one lb. in 1 gallon of water. Many weeds can be destroyed with much weaker solutions, even as weak a dilution as 1 per cent. The rate of application will, of course, vary according to the amount of vegetation. One hundred gallons of solution is usually sufficient to treat 1 acre of weed growth, but with weeds that make heavy growth the quantity should be increased to about 150 gallons. All the leaves of the weeds should be well moistened with the

solution, and, as the spray is more effective and economical of material when in the form of a mist, spraying machines on the compressed air principle are the most suitable for its application. For the destruction of deep-rooting weeds it is generally necessary to make two sprayings, any new growth made by the plants being sprayed about six to eight weeks after the first spraying. Unlike that of many other weedicides, which rapidly kill the top growth but do not destroy the roots, the action of sodium chlorate is very slow; at first comparatively little effect is noticed, but the plants gradually wither, the roots become exhausted, and finally the whole plant dies. The sprayed areas should be left undisturbed for a period of three months after spraying.

The best time for spraying weeds is as a rule, when they are in full bloom, and the action of sodium chlorate is more rapid when the air is moist. Rain following a short time after spraying does not hinder the action of the spray.

Sodium chlorate is poisonous to stock if taken in sufficient quantity. For safety, stock should be removed from sprayed areas until the weeds have been well washed by rains and care should be taken that stock do not have access to unused spray, which they will readily drink. Materials which burn easily, if sprinkled with a solution of sodium chlorate, are rendered more inflammable and fine straw, clothing, etc., that have been moistened with the solution and allowed to dry may be ignited by friction or from a spark, and thus constitute a fire menace. It is therefore inadvisable to prepare the solution inside sheds, and if the clothing become saturated with the solution, it should be thoroughly rinsed before being allowed to dry. *(Agricultural Gazette of New South Wales.)*

Milk Insurance.—Rather a strange title for a note on dairying practice but, feeding a dry cow is an insurance against next year's low yield, and nothing else. The great majority of dairy farmers seem to think that when a cow is dry she does not need any special attention in feeding. This is a big mistake, because it is just as important to feed a good cow when she is dry as it is to feed her what she needs when in milk. The conclusion arrived at after many conversations with dairy farmers is that the dry cow, not being revenue-producing, is looked upon as a nuisance among the cows in milk; and also that a dry cow costs money to feed and maintain. They evidently do not appreciate the fact that nothing on four legs is nearer perpetual motion than the cow, either milking or dry. It must be

thoroughly understood that the dry cow is doing three very important things for herself, her owner, and the dairying industry-building up the calf's body, storing up fresh tissue within her own body to draw upon when she freshens, and maintaining her own health. It is quite certain that water and dry grass will not do these things, and if a cow gets nothing else than water and dry grass the flow of milk when she freshens will soon diminish, and likewise the profits. In a newly freshened cow the supply of milk is fairly good; when without any apparent reason the supply slackens off instead of keeping up for some months, you have silent evidence that she was not given the feed she should have had when dry. It must be thoroughly understood that the cow builds up her worn out body tissues, builds up flesh, blood, and bone of her unborn calf, and also makes the milk she gives from the feed that is given to her. If a cow is a heavy milker she makes great demands on the reserved nutrients and minerals she stored in her body, and these can only be placed there by feeding. During the time she is dry she uses the feed she eats for body building and development of her unborn calf, but if you neglect to feed her during the dry period, it is the cow that goes short, but not the calf. In consequence, the cow calves in poor condition, and has no reserves to draw upon. It can be seen from this that the cow that is fed while dry lays up a reserve store of flesh and she has that to draw upon for some weeks after freshening. This will enable her to come to her full flow at about the time the cow that was not fed when dry begins to go off in her milk. The dry cow should be looked upon as a prospective milker and not as a nuisance. But is she? Where good pasturage is obtainable light feeding only is necessary, but on no account should she be allowed to approach the period of exhausting labour in a low or indifferent condition. *(Queensland Agricultural Journal.)*

Indian Mangosteens in London.—The first consignment of Indian Mangosteens to be placed on the London Market was sold out in 24 hours, so great was the demand for this newcomer to Covent Garden. The consignment, which consisted of one thousand fruits, was sent from Burma to the Empire Marketing Board as an experimental shipment, and arrived in such good condition that a decision to market most of it as an experiment was made. The mangosteens were handed over to Messrs. Poupart's a big Covent Garden firm of fruiterers, and were sold at several West-end-stores at 4*d*. each. There was a rush to buy them, and the fruit was all sold by the same evening. A large number

of orders have already been received for the next consignment, which is due in about three week's time. This is the third successive season in which the Empire Marketing Board had handled experimental shipments of mangosteens. The fruit is greeted on arrival by the Board's scientific officers, who have made various recommondations for the improvement of transport and packing. Partly as a result, a successful method of carrying this extremly delicate fruit to London in cool storage has been worked out, and it is hoped that a new trade in mangosteens will shortly be developed. (*Agriculture and Live-stock in India.*)

Live-stock By-Products.—By products obtained from the slaughter of live-stock enter into hundreds of articles in daily use at the present time, ranging from boots and shoes, machinery belting, soap, candles, glue and fertilizer to animal and poultry foods, while medical science obtains insulin and serum and many pharmaceutical products from the same source. In a paper on Live-stock by-products and by-products Industries recently read by Mr. G. R. White before the Royal Satistical Society it was computed that the value of the manufactures from live-stock by-products in this country was not less than £ 121,000,000 in 1924, the year of the last completed Census of Production, while £ 97,000,000 of this total represented the contribution of these industries to the national income of the country. The total output was £ 10,000,000 more than the total value of all the live-stock sold for slaughter in the United Kingdom, and was more than twice the value of the output of the shipbuilding or chemical industries in the same year. In 1924 the live-stock by-product industries gave employment to 350,000 persons or two-thirds of the number employed in the cotton industry and 25 per cent more than the number employed in the woolen industry. An interesting point brought out in the paper was the fact that since 1925 world stocks of cattle have remained relatively constant at about 12 per cent above the pre-war level. (*Mysore Economic Journal.*)

Rain to Order—Experiments in Artificial Production.—The prospect of inducing a greater resonableness in nature with respect to its rainfall habits is a matter of perennial interest to the farmer, and that it is within the realms of the possible is indicated by an article in the November *Agricultural Gazette of New South Wales.* Two American Scientists Professors Warren and Rancroft, it is stated, have successfully

produced rain in a series of experiments based on the natural process which takes place in the upper atmosphere. Moisture is always present in the upper atmosphere in the form of minute drops, so light that they remain in suspension. When particles of dust come in contact with the drops of moisture they are absorbed, thus increasing the weight of the drops. As a result of their electric charge (positive or negative) the particles tend to become aggregated into masses too heavy to remain in suspension and then fall as rain. Thus, clouds formed of vapour too light to fall as rain may be artifically weighted by electrically charged dust and immediate rain produced.

Acting on this theory a load of electrically charged sand was dropped from captive balloons on to clouds. Rain fell immediately. Professor Bancroft calculates that 40 lbs. of electrified sand would be sufficient to dissolve into rain 1 square mile of clouds.

In subsequent experiments an aeroplane was used carrying sand with a charge, partly positive and partly negative of 12,000 volts. The machine rose and disappeared among the clouds while spectators below awaited the miracle, which proved even more dramatic than before. The clouds burst in violent shower of rain, while at the same time the sky cleared and the sun shone again.

In the Netherlands Professor Veraat has succeded in producing rain over an area of about 8 square kilometres by throwing finely divided "dry ice" *i. e.*, solid carbon dioxide, from an aeroplane on to clouds. Similar experiments had been tried previously by various scientists using powdered kaolin, but had not given satisfactory results. Professor Veraat rose to a height of 2500 metres in an aeroplane carrying 1½ tons of "dry ice" and fitted with a special spreading apparatus; he then let the powder fall on to clouds 200 metres below. Abundant rain immediately fell. The experiment was officially controlled by observers in four military aeroplanes.

Professor Veraat explains the formation of rain by supposing that during the fall from the aeroplane to the clouds the particles of solid carbon dioxide, become electrically charged and transformed into microscopic drops of liquid carbon dioxide, which caused condensation in the clouds and consequently a fall of rain. According to Professor Veraat this method will also make it possible to ensure fine weather

when desired. By converting the clouds into rain early in the day he holds that a clear sky may be assured in a given locality for the rest of the day.

World's Champion Cow.—35,625 lbs. of milk and 1493 lbs. of butter in 365 days—this is the record of Lady Pride Pontiac Lienwkje, a Holstein cow of Minneapolis Minnesota. She has thus beaten all previous records for combined milk and butter production in the world. This cow is owned by Mr. Murphy publisher of The Minneapolis Tribune and is the daughter of Lady Pride, one of the best two year-olds of her time with a record of 860 lbs. of butter and 20825 lbs. of milk. Her granddam K. P. Lilith Clothilde was a world's champion in her own time with 1043 lbs. of butter and 22229 lbs. of milk as a four years old (*Phillipine Agriculturist.*)

An Electric Taster.—An "electric palate" or Electrynx, that tastes and indicates on a meter the ripeness of apples, oranges, lemons and other fruits and vegetables, by measuring their acidity has been developed by R. C. Hitchcock, electronic engineer of Westinghouse Electric and Manufacturing Company. The small portable device also registers the acid content of tea and coffee. By proper application of the Electrynx, canners and preservers of fruits and vegetables will be able to keep the flavors of their products at a given standard because it will be possible for the samplers at the various orchards and fruit exchanges throughout the country to select the raw product more scientifically. Other tests made with the Electrynx were the determination of the acid condition of the human mouth, palm of the hand, the hair, and other parts of the body. (*The Scientific America*).

Be Kind to the Cow.—One of the duties a dairy farmer too often neglects is to train his boys how to milk properly. To begin with, the farmer himself must be neat and clean at the job, otherwise he cannot set a good example. He must never permit wetting a cow's teats when milking, as it is a dirty practice, and it makes the teats chap and become sore in cold weather. A small amount of vaseline may be rubbed on the hands if there is difficulty in milking dry, and it proves beneficial. Another thing to instill in a boy's mind is, that it pays to be kind and patient with the cows at milking time in fact, at all times. It is well known that one man can get more milk than another man from the same cow and with the same feed. Beating a cow with a milk stool when she

kicks or switches her tail sometimes "adds insult to injury." The milker is more often to blame for the cow's fear in letting down her milk than is the cow. The only way to overcome this fear is for her caretaker to be patient and gentle with her. *(Queensland Agricultural Journal.)*

Commercial treatment of Water Hayacinth.—According to a message of the Associated Press of India Dr. H. K. Sen of the University College of Science Calcutta, claims to have discovered a very effective method for the treatment of water hayacinth on a commercial scale. A powerful bacterium capable of fermenting cellulose and carbohydrates in general has been isolated from horsedung. This bacterium completely and readily ferments arabinose and xylose which form the most import constituents of straw and straw like substances and saw dust, giving alcohol, acetic acid and formic acid. This bacterum, therefore affords a ready means of converting waste cellulose and semi cellulose into important commercial products. From an experiment made in the laboratory it appears that a ton of dry water hayacinth yields 2 gallons of spirit and 1½ cwt. of mixed volatile acids in addition to 2 cwts. of potassium chloride. This renders the commercial treatment of water hayacinth a profitable undertaking.

Silage and Grass—Relative Feeding Values.—The question is frequently asked: Is silage equal in feeding value to green grass? It must be said at once that silage is not equal to an ordinary mixed pasturage, though it is a very good substitute. Mixed pasture, on a fairly good soil, is almost ideal feed, as it is made up of many kinds of true grasses, legumes, and other herbs. It is therefore fairly well balanced in regard to protein and carbohydrates, and is also extremely palatable, which is an important feature. Pastures made up entirely of one kind of grass, such as those of the coast, where *paspalum* has possession, are not entirely satisfactory owing to the lack of variety. As a rule, silage is made from one crop only generally either maize, sorghum, or winter cereals, and as these are weak in protein the silage is somewhat deficient in that very important food constituent. For this reason it has been found economical to add concentrates when feeeding. Silage will maintain stock in good condition without the admixture of other feeds, but much better results are obtained by using with it such foods as bran, pollard, oilcake, or lucerne hay. *(Queensland Agricultural Journal.)*

Current Research

Relation of Weather to the Prevalence of Wheat Stem Rust in Nebraska.— George L. Peltier *(Journal of Agricultural Research* Vol. 46. 1933 pp. 59-73.) A study of the time and length of the fruiting period of wheat in a 28-year period shows that stem-rust epidemics did not occur in eastern Nebraska when winter wheat headed prior to, or during the first week in June and ripened before the first of July. The short fruiting period prevented the development of many urediosporic generations, and the environmental factors conducive to early maturity of winter wheat usually inhibited the rapid development of stem-rust. These years may be classed as rust escaping. Rust epidemics occurred during occasional years within this period but were not correlated in all instances with an extended fruiting period because during other years with the same length of the fruiting period little or no rust developed.

An intensive study, over a 10 year period, of a number of factors influencing the development of stem-rust leads to the conclusion that a rust epidemic is possible in the winter-wheat area of Nebraska only when a certain combination of factors is present in sequence. These factors are (1) A large amount of initial inoculum reaching Nebraska when conditions favour maximum infection and the subsequent production of large numbers of primary uredia over a wide area (2) winter wheat entering the heading stage the first week of June or thereafter, with primary uredia appearing at about the same time; and (3) an extended fruiting period, during which optimum temperature, an evenly distrubuted precipitation above the normal, and other favorable conditions are at hand for the rapid development of urediosporic generations.

Apparently low temperatures are the major limiting factor in the development of primary infection and subsequent development of uredia, whereas the lack of an even distribution of sufficient precipitation is the major inhibiting factor in the development of subsequent urediosporic generations during most years.

Fortunately the sequence of factors necessary for stem-rust epidemics are fulfilled only in occasional years in the winter-wheat area of Nebraska. They may occur, however, in two successive years as in 1919 and 1920, or at intervals of as long as 12 years as in 1904 and 1916 with none between (*Author's Summary.*)

The marketing of Nagpur oranges.—P. D. Nair (*Agriculture and Live Stock in India* Vol. II 1932. pp. 589-602). The Nagpur orange known in

the vernacular as *Santhra* has an all-India reputation and is undoubtedly the best of its kind grown in India. All the important villages famous for the production of oranges lie within a radius of 50 miles from Nagpur. The orange trade of this locality has been steadily growing since the beginning of this century. In 1906 the area under oranges in Nagpur District was estimated at a thousand acres and the value of the export trade at a lakh of rupees. In 1931 the area under oranges in the Nagpur District alone amounted to 5559.25 acres and the total value of the export trade from this region was about 25 lakhs. The opening of the new railway lines to Itarsi and Kazipet has widened the market and has given a great stimulus to the trade in oranges. Between 1925 and 1929 the trade has increased more than fourfold.

There are two crops of oranges in this tract, the *ambiabar* and the *mrigbar*. The *ambiabar* blossoms in February-March and the fruits arrive in the market from about the middle of September and continue till the end of December. The *mrig* crop blossoms in June-July and the fruit is ready by February and continues till the middle of May. Thus there is a continuous supply of oranges from this tract for over nine months in the year. Nagpur is the chief marketing centre. There is also another market at Katol, about thirty miles from Nagpur.

About 80 percent of the fruits that come into the market are bought by traders known as *Beparis*. The owners of gardens prefer to sell the standing crop to traders in advance. In both the Nagpur and Katol markets sale is effected by auction through the *dalals*. By far the largest part of the orange crop of this province is still disposed of in either the Katol or the Nagpur market. The *dalals* are the principal financiers particularly in the area served by the Nagpur market. They advance large amounts to the traders for buying the standing crop during July and August. The expenses of marketing oranges at Nagpur amount to Rs. 5-1-6 per cart and at Katol to Rs. 4-7-0. If the average whole sale value of a cart load of oranges be taken to be Rs. 25 the expenses of marketing at Nagpur amount to about 20 per cent of the value of the produce marketed. This does not include the cost of transport to market which varies according to distance. The methods of handling the fruit as practised here are very crude. The rough and ready methods adopted by the people when oranges travelled only a few miles and reached the consumer in a few hours are still the methods in vogue. From the garden to the market the fruit is transported in the ordinary country cart. For export purposes the fruits are packed in small baskets made of bamboo chips and capable of

holding about 75 to 100 fruits. During the busy season the fruit is despatched loose in ordinary railway wagons without any kind of packing. Merchants say that ordinarily about 20 to 30 percent of the fruit is damaged in packages, and when sent loose over long distances the damage is of the order of 40 to 50 percent and some times is even more.

The effect of ammonium sulphate on plant growth.—A. H. Lewis and F. B. Marmoy (*The Journal of Agricultural science.* Vol. XXIII 1933. pp. 1 to 5). The opinion is often expressed that sulphates exert a toxic effect on plant growth. Further, if applied to the soil at the same time as acid salts such as monocalcium phosphate, sulphur dioxide may be liberated from sulphites with a consequent harmful effect on germination and growth. Since sulphate fertilizers such as ammonium and potassium sulphate may contain small amounts of sulphites it is necessary to know whether a small amount of sulphite in sulphate fertilizers has any harmful effect on plant growth. A review of the literature gave conflicting evidence as to the effect of sulphites on plant growth so that a pot culture experiment was conducted to study the effects of the addition to ammonium sulphate of varying amounts of ammonium sulphites on the germination growth and yield of mustard and rye on a heavy loam soil. Under the conditions of the experiment described, ammonium sulphite had no adverse effect on the germination growth and yeild of dry matter of mustard or rye.

The Relation of size and shape of plant to the yield of Cotton—S. N. Venkatraman and C. Jagannath Rao (*Madras Agricultural Journal,* Vol. XXI 1933 pp. 51-57.) The relation of height, nodes and number of monopodia to the yield of cotton was investigated in 6000 plants, being the progeny of forty six selections of Northerns cotton (*G. indiceum*) grown at Nandyal.

It was found that in plants of the same strain, the number of monopodia and height of plant were markedly corrected with yield. The genetic relation from strain to strain was however different. While taller types were not necessarily good yielders, strains with more monopodia were more productive. The number of nodes was not of much significance towards yield either from plant to plant of the same strain or from one strain to another.

The correlation of yield to other characters was significantly more in normal plants than in those attacked by the shoot borer (*Earias sp.*) A study of the regression of the plant yield on these characters showed that

the relation of monopodia and to a large extent of height was rectilinear This shows a proportionate increase of yield with increase in these characters. The regression on nodes was more complex.

From an examination of yield from bored and normal plants in all the strains, it was found that the attacked plants gave a significantly higher yield. This increase of yield was associated with an increase in the number of monopodia per plant, as well as an increased rate of productivity per monopodium. It was also observed that the higher on the mainstem the attack, the greater the yield. This was not however the case from one strain to another.

From a comparison of other strains, as Combodia and particularly Uppam (*G. herbaceum*) where the effect of borer was just the reverse, it was shown that the difference in behaviour could be attributed to the more monopodial habit of this type.

The relation of yield to monopodia was much higher in this Cotton than in more sympodial types as Americans or Uppams. Selection for high yielders on the basis of monopodia is justifiable in "Northerns" Cotton (*Author's Summary.*)

Influence of Rye and Oat Straws upon the Growth and Yield of Certain Vegetables. (*Soil Science* Vol. XXXV 1933. pp. 115–122.) Among the soil problems which arise in connection with truck farming the lack of sufficient quantities of organic matter is of great importance. Much work has been done at the Rhode Island Agricultural Experiment Station in connection with the efficiency of substitutes and supplements for stable manure in vegetable notations. Fertilizer chemicals combined with stable manure have given better yields than stable manure alone. Green manure and fertilizer chemicals have failed to produce as high yields as fertilizer chemicals and stable manure. Combinations of stable manure green manure, and fertilizer chemicals have proved very efficient.

In addition, it was thought that another method of substitution might be the use of straws coupled with ample quantities of fertilizer chemicals. To this end experiments were carried on over a period of years by growing certain vegetables in pots using soils to which varying amounts of straw were applied.

Experiments show the inhibitory effect upon plant growth of large quantities of poorly decayed organic matter. By the use of various levels of rye and oat straws of different composition and stages of decomposition an attempt was made to determine the value of these

sources of organic matter in connection with the growth of lettuce, celery, beets, carrots, onions, and spinach. These pot tests seem to show the following.

Such resistant organic matter sources have doubtful value as substitutes for stable manure. This is especially true where the nitrogen content of the straws is very low.

Evidence is given to show that, although it may be possible to balance the inhibitory effect which accompanies the decomposition of low nitrogen straws by very large applications of nitrogen, these are of necessity so large as to be out of reason for field practice.

Crop Forecasts

(Extracted from the Central Provinces Gazette.)

WHEAT

Central Provinces and Berar, second forecast for 1932-33.—On an average of the five years ending 1930-31 the area under wheat in C. P. and Berar has represented about 10·3 percent of the total area under the crop in British India. The estimated area under wheat in C. P. and Berar during the current year is 3,469,490 acres as against 3,367,147 acres reported in the corresponding forecaste of the last year thus showing an increase of 3 per cent during the current year.

Outturn.—The season was not unfavourable at the outset but the growth of the crop was affected generally by the absence of timely winter showers and by the cloudy weather followed by unseasonable late rainfall and hail. In Chattisgarh the outturn is not below, while in Saugor, Nimar and Balaghat it is rather below normal. In other districts the yield is estimated at from 67·5 to 90 percent of the normal. For the Cetral Provinces and Berar together the outturn works out to 83 percent against the correspoding estimate of 93 and the actual outturn of 75 percent in the previous year. A total yield of 741,800 tons is anticipated against 8,086,000 tons estimated at this time last year.

United states' winter wheat crop.—The production of the winter wheat crop of the U.S.A. for the current season is now estimated at 334 million bushels (=8·9 million tons). The condition of the crop is reported to be 59·4 percent of the normal. Last season's corresponding estimates were 458 million bushels (=12·3 million tons) and 75·3 percent, respectively. (*The Indian Trade Journal.*)

GROUNDNUT

Central Provinces and Berar 1932-33.—On an average of the 5 years ending 1930-31 the area under groundnut in the Central Provinces and Berar has represented some 1·7 percent of the total area under the crop in British India. The area sown with groundnut in the Central Provinces and Berar is estimated to be 181,820 acres as against 159,960 acres and 164,333 acres the estimated and actual areas of last year. For the province as a whole the outturn works out to 77 percent of the normal with an yield of 44,250 tons against 68·2 percent with an yield of 31,900 tons estimated last year.

SUGAR CANE

Central Provinces and Berar, Final Forecast 1932-33.—On an average of the five years ending 1930–31 the area under sugarcane in the Central Provinces and Berar, represnts about 0·8 percent of the total area under the crop in British India. The total area under sugarcane in Central Provinces and Berar is estimated to be 25,696 acres. It exceeds the actual area (22,042 acres) of last year by 17 percent and also the Quinquennial and decinnial averages by 15 and 19 percents respectively. For the province as a whole the outturn works out to 111 percent of the normal expressed in tons. The estimated yield for the whole province comes to 40,820 tons against the actual yield of 34,530 tons in 1931–32. It exceeds the five and ten year's averages by 19 and 36 percent respectively. The excess is due partly to the increase in area during the current year and partly to the revision of standard outturn for important cane growing districts.

COTTON

Central Provinces and Berar—fourth forecast 1932-33.—On an average of the five years ending 1930–31 the area under cotton in the Central Provinces and Berar represents about 19·4 percent of the total area under the crop in British India. The provincial area now stands at 42,15,983 acres or 53,453 acres less than in the third forecast.

Outturn—The provincial estimates now work out to 9·1 annas or 68·2 percent of the normal or 7,55,600 bales against the yield of 41 percent or 5,05,800 bales in 1931–32. The number of carts of kapas which arrived in the markets of Central Provinces and Berar from 1st September 1932 to 28th January 1933 was 542,455 against 226,081 and 951,695 during the corresponding periods of 1931–32 and 1930–31 respectively. The total number of bales pressed according to cotton press returns up to the 27th January 1933 was 387,909 against 147,950 at the same time last year.

College News

The period preceding the annual exminations is a very busy time for the students. All activities are suspended and the students concentrate on their books. Consequently there is little by way of social or sporting activities worthy of being recorded here.

* * * *

A short course in practical Dairy farming for the benefit of the *Gowallas* and small dairy farmers was started in the College Dairy last November. The classes were conducted in the vernacular and consisted of practicals and lectures. The course was started more as a feeler to find out if there is a real demand for that type of training. Out of 31 applicants 25 were admitted to the course. A few dropped off in the middle and finally 14 appeared for the examination in march. The course seems to have been a success as most of the students who joined the class were either dairymen themselves or were contemplating to start dairy business.

* * * *

The third year students went on their usual study tour to the wheat tract during the first week of February. The Principal Mr. J. C. McDougall and the lecturer in Agriculture Mr. B. S. Rao accompanied them. They visited the Powarkheda farm near Hoshangabad and the Adhartal farm near Jubbulpore. The students took this opportunity to visit the famous Marble Rocks near Jubbulpore.

* * * *

The College examinations this year started a little early to enable the results to be published before the closing of the College. The results were on the whole satisfactory. We offer our congratulations to those who have come out successful. While sympathising with those who have unfortunately failed we would remind them that "failure is but a stepping stone for noble minds to success."

As we go to press the results of the B. Ag. and Intermediate examination are published. Out of the twenty eight students who appeared for the B. Ag. examination, twentyfour have passed, two got compartmental in Botany and Plant Pathology and two failed. It is unfortunate that there has been no first class this year in the B. Ag. In the Intermediate Agriculture out of a total of 37 who appeared for the examination 33 have passed, 2 obtained compartmental in Mathematics and 2 failed. Three have secured 1st class. The results of the University examinations are indeed creditable both to the students and the staff and we congratulate them on their achivements.

We take this opportunity to congratulate Mr. S. B. Vaidya one of our editors, for standing first in the B. Ag. examination. Mr. Vaidya has evinced considerable enthusiasm in the affairs of the Magazine and has helped to increase the number of our subscribers this year. Mr. Vaidya is an intelligent young man of winnig manners. We wish him all success in whatever walk of life he enters.

* * * *

To the B. Ag.s who have just left College we wish to say a word " You have come to a successful termination of your College career and you will soon enter the highway of life. Your success in that journey depends upon how you make use of the equipment that you have so laboriously acquired while in this College. Do not for a moment think that you have "finished" your "education" or that you have ceased to be a "student." In fact you have only just begun. Keep burning the torch of learning and remember that you have a great responsibility to perform, that of ameliorating the condition of the three hundred millions of Agriculturists of this country. The times are not propitious and it may be that some of you will take a little time to reach your goal. But do not repine ; strive on with a will to win. There is no surer way for success than to be optimistic. The Following is an extract from a speech by Sir William Muloch, the Chief Justice of Canada, and the oldest member of the Judicial Bench in the British Empire, and it will instill that spirit of optimism in you. This is what that wise Judge—88 years young said:—

> 'I am still at work with my hand to the plough and my face to the future. The shadows of evening lengthen about me but morning is in my heart. I have lived from the forties of one century to the thirties of the next, have had varied fields of labour, and full contact with men and things, and have warmed both hands before the fire of life. The testimony I bear is this: that the castle of enchantment is not-yet behind me, it is before me still, and daily, I catch glimpses of its battlements and towers. Mine, too, are the precious things of today—books, flowers, pictures, nature, and sport. The first of May is still an enchanted day to me; the best thing of all is friends. The best of life is always further on. Its real lure is hidden from our eyes some where beyond the Hills of Time!'

Fine words and true! Cultivate that spirit of optimism and do your best, and you are sure to succeed.

One thing which all ex-students of this College should bear in mind is to keep alive their connections with this College. It has both a moral and material value. Perhaps the best way of keeping in touch with the College is to be in touch with the College magazine. Read the College magazine, contribute short articles to it or write letters to the Editors giving an account of any interesting experience you have had in your outdoor life so that the Editor can make out a short note on it which might interest other readers. This will keep up your interest in the College and will keep alive the interest of others in you. We hope that our new B. Ag.s who are just leaving the College will bear this in mind and try their best to keep in touch with their old College and their old friends.

* * * *

The closing of the last session of the College was marked by the departure on leave of our Principal Mr. J. C. McDougall, for six months and a half. Mr. McDougall has been at the head of the College for more than a year. This period has been one of exceptional difficulties owing to financial stringency, retrenchment and political excitement. But Mr. McDougall has steered clear of all these difficulties with great success. The College work went on very smoothly all through the year, and the results at the University examinations have been splendid. Mr. McDougall has shown great concern in all matters affecting the students. He has visited every sick bed morning and evening whether in the hostel or in the hospital. No student who went to him for help or advice ever came back disappointed. His sympathy and uprightness have won the hearts of the students and staff alike. We wish him and Mrs. McDougall all happiness during their stay at home and look forward eagerly to their early return.

* * * *

We accord a hearty welcome to Mr. John H. Ritchie, M.A., B. Sc., who has taken over from Mr. McDougall the principalship of the College. Mr. Ritchie is not new to this province. He is the second senior officer of the C. P. Department of Agriculture and has worked in various parts of this province. He now comes back to us after a brief absence during which period he very successfully held the post of the Secretary, Indian Central Cotton Committe. Wherever he has been Mr. Ritchie has establised a reputation as a very able and sympathetic officer. During the short period he has been with us in the college he has shown great interest in all matters concerning the College and the future of the graduates. We wish him all success.

Examination Results 1932-33

B. Ag. EXAMINATION, NAGPUR UNIVERSITY

Second Class.

1. B. M. Chandel
2. E. D. Pimpleker
3. H. S. Dhalloo
4. H. P. Dwivedi
5. H. K. Sen
6. H. K. Das
7. J. P. Tiwari
8. J. G. Bhalerao
9. L. B. Deshpande
10. L. P. Khare
11. M. Akram.
12. M. K. Nagmoti
13. N. P. Deshmukh
14. N. B. Chinchalker
15. R. N. Deshpande
16. S. B. Vaidya *
17. S. L. Vishnoi
18. S. C. Bhatacharya

Third Class.

P. S. Datta

R. L. Sing

S. A. Rahman

Pass.

B. P. Rawat

N. K. Ghosh

D. C. Kelker

Compartmental.

Mahmad Ishaque	Botany and Plant Pathology
R. N. Kher	Do.

INTERMEDIATE EXAMINATION IN AGRICULTURE NAGPUR UNIVERSITY

First Class.

K. G. Joshi*

Biswanath Sahu

V. G. Vaidya

* Awarded the Sir Arthur Blennerhasset Memorial Medal for standing first at the B. Ag. examination.

Second Class.

A. B. S. Verma
B. Datta
D. Patnaik
H. Misra
H. R. Shrevastav
K. R. Chande
P. M. Ganorker
P. Misra
R. D. Mukerjee
R. A. Haqqani
S. N. Walkade
S. M. Ali
T. P. S. Choudhari
V. Taparia
V. S. Hinganker

Third Class.

G. M. Bawsay*
G. W. Pitale
N. W. Tilloo

Pass.

B. S. V. Rao
H. A. Kaiyumi
K. G. Wadnerker
K. S. S. Chouhan
S. K. Bhisey
P. N. Soman
S. G. P. Tiwari
S. A. Rasheed
T. N. Puranik
Y. K. Dhabadker
N. N. Bhide
S. Bhandari

Compartmental.

R. L. Gupta	Maths. and Agrl. Eng.
S. M. S. Hassan	Do.

THIRD YEAR PROMOTION EXAMINATION

(in order of merit.)

1. D. Misra
2. Mohd. Zafar Ali Khan
3. P. V. Bhagwat
4. S. S. Ambadekar
5. K. B. Rahurkar
6. S. K. Dharmadhikari
7. B. P. Dwivedi
8. P. Tiwari
9. L. B. Deshpande
10. N. P. Konher
11. D. N. Gour
12. G. C. Baruah

The following students are promoted subject to their passing another test in the subject shown against their names.

1.	A. M. Chaudhary ...	Chemistry
2.	G. L. Deshkar ...	Do.
3.	M. M. Khirey ...	Do.
4.	P. M. Joseph ...	Do.
5.	S. L. Neema ...	Do.
6.	H. Misra ...	Entomology

* Awarded the Sir Arthur Blennerhasset Memorial Medal for standing first at Inter. Agri. Examination.

FIRST YEAR PROMOTION EXAMINATION

(In order of merit.)

1. T. J. John
2. D. L. Chandore
3. Sukumaran Nair
4. R. S. Shivalkar
5. B. L. Udhalikar
6. H. N. Mukerji
7. U. G. Deshpande
8. M. D. Anadeo
9. D. R. Soman
10. M. I. A. Khan
11. B. K. Ghosh
12. W. R. Deshpande
13. D. Chandrayya
14. Lal Harnarain Singh
15. D. P. Sharma
16. M. P. Kashyap
17. G. K. Bhake
18. Kunwar Raj Singh
19. Khageshwar Singh
20. W. S. Vyawahare
21. Syed Kazim Hussain
22. K. N. Lele
23. M. K. Deoskar

The following students are promoted subject to their passing an examination in Chemistry and Botany.

1. V. T. Tanksale
2. P. K. Mukerji

RESULT OF THE FINAL TEST EXAMINATION OF THE VERNACULAR DAIRY CLASS

1.	S. R. Alsi	...	1st Division
2.	V. R. Karmalkar	...	Do.
3.	R. S. Risbud	...	Do.
4.	J. K. Jain	...	2nd Division
5.	R. D. Munshi	...	Do.
6.	P. R. Kolhatkar	...	Do.
7.	V. S. Masania	...	Do.
8.	R. A. Ketkar	...	Do.
9.	Laxmanrao Hiranwar	...	Do.
10.	O. P. Tiwari	...	Do.
11.	Bhagwan Das	...	3rd Division
12.	T. V. Varadpande	...	Do.
13.	Jai Sri Ram	...	Do.
14.	M. N. Khadakkar	...	Do.

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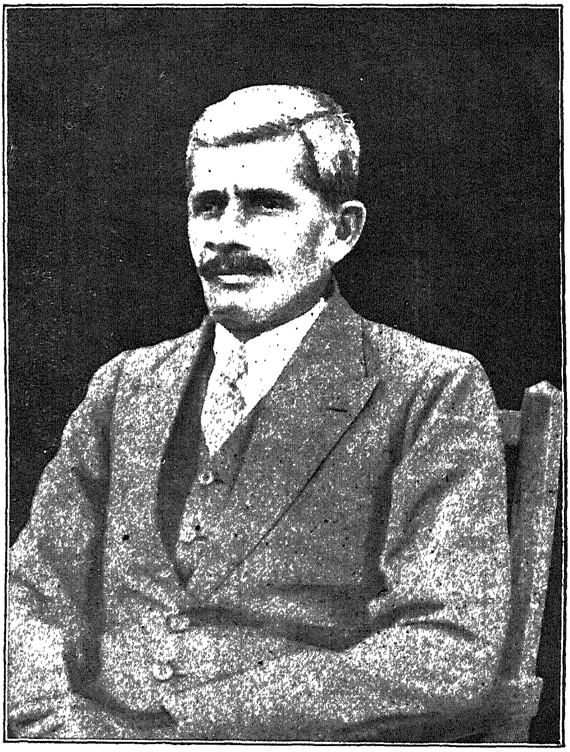

RAI BAHADUR TUNDILAL OKHARAM POWAR.

RAI BAHADUR TUNDILAL OKHARAM POWAR

The retirement of Rai Bahadur Tundilal Okharam Powar removes from the cadre of the C. P. Department of Agriculture one of the pioneers of Agricultural improvement in this Province. The Rai Bahadur was deputed as an E. A. D. from the Revenue Department to the Agricultural Department in April 1911 and was posted to Raipur, as Superintendent of the Labhandi Farm. From that date onwards till the time of his retirement he spent the whole of his service in Chhattisgarh, either as Extra Assistant Director or as Deputy Director, of Agriculture. His long residence there gave him an unique insight into the country's rural and agricultural conditions and brought him into intimate contact with the cultivators of the tract, a fact which contributed not a little to the success of his propaganda for agricultural improvements. He was a very hard working and conscientious officer and won golden opinions from all quarters. In recognition of his valuable services to the department of agriculture the title of Rai Bahadur was conferred on him in 1926. We wish the Rai Bahadur a long and happy retired life and a further period of usefulness to his countrymen in his private capacity.

RAI SAHEB BHAIYALAL DUBE

Rai Saheb Bhaiyalal Dube who has just retired from the Central Provinces Department of Agriculture after a long and meritorious service extending to 31 years is one of the small band of early workers who played an important part in organising and establishing the work of the Department in its infant days. This College can claim him as one of its *alumni* as he was a student in the old Nagpur Agricultural School before he joined the Science College, Poona, where he took his diploma of Licenciate in Agriculture. He joined the Department in 1902 as a teacher in the Agricultural School at Nagpur. He was then transferred to the field staff and later promoted to the provincial service. He was for a long time Extra Assistant Director of Agriculture in Berar, where he played an important part in introducing *Roseum* cotton which brought immense wealth into Berar during the war and post war period. In recognition of his services the title of Rai Saheb was conferred on him in 1914. From 1919 onwards he worked, for the most part, in the Northern Districts, where he officiated as the Deputy Director of Agriculture, Jubbulpore on several occasions. Wherever he worked Rai Saheb was very popular both amongst the Agriculturists and the officers of the Department. We wish Rai Saheb a long and happy life to enjoy his well earned rest.

RAI SAHEB BHAIYALAL DUBEY.

The Nagpur Agricultural College Magazine

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Editorial

THE JAPANESE BOYCOTT AND THE INDIAN COTTON GROWER

The action of the Government of India in suspending the Indo Japanese Trade convention and raising the minimum specific duty on non-British plane grays from 5¼ to 6¾ annas and the *advalorem* rate from 50 to 75 per cent has affected variously the three countries India, England and Japan, the later two being the principal countries interested in Indian textile trade. Lancashire has welcomed the new tariff as it gives them a 50 per cent preference in the Indian markets. The Japanese industrialists, on the other hand, take it as an extremely discriminating measure deliberately aimed at crippling Japan's trade with India and have determined to retaliate by boycotting the use of Indian cottons. In India however the opinion is conflicting. The mill owners of Bombay feel that this increase in tariff rates, though belated, would give them some relief from the unfair methods and cut throat competition of Japan. The cotton growers of India, on the other hand, are full of apprehensions; for Japan is the most important customer for Indian cottons at the present time, and if she gives effect to her boycott threat it would result in dull markets and a serious drop in prices.

Can the Japanese really give effect to the boycott resolution

passed by the cotton spinners association at Osaka, or is it simply intended to bluff the Government of India and the Indian legislature so that they might repeal the new duties? The opinion in the industrial circles of Bombay is that Japan cannot possibly boycott Indian cotton without jeopardising her own textile industry. Comparing quality against price the Indian cotton is the most attractive stuff of its kind in the world and that is just the cotton that Japan wants for manufacturing her cheap cloths. It will be difficult for them to manage without Indian cotton as they have been buying such large quantities of it in the past; and their machinery and technicians are all specialized in working it. Thus discarding Indian cotton would mean a reorganisation of the whole textile industry and the present is hardly an auspicious time for it. Further if Japan boycotts Indian cotton, India would retaliate by boycotting Japanese goods of all description. Japan would not court a calamity of that nature as India is an important customer for her manufactured products. In 1930 the total imports from Japan was valued at 24 crores of rupees of which about 8 crores represented goods other than textiles. No one can afford to lose such an important market.

Japan's anxiety to buy Indian cotton and to retain the Indian market cannot however be made much of. Japan can buy the cotton she needs from several other sources. Of late Japan's purchases of cotton in India has been falling, owing to the cheapness of American and other cottons. Newspaper reports say that Japanese merchants are busy trying new sources of cotton like Persia and Belgian Congo as alternatives to the Indian supply. She might also buy some of the cheaper grades of American cotton and mix it with the still cheaper grades of Chinese cotton and evolve a new mixture and new technique. As for the chance of losing the Indian market for her goods, Japan is confident that her goods can compete

successfully with the goods of any other country and climb even the highest tariff walls by virtue of her cheap and efficient labour and superior organisation.

If Japan should really give effect to the boycott threat how will it affect the Indian cotton grower? Roughly it may be said that India produces annually about 60 lakhs of bales (of 400 lbs) of which about 14 to 15 lakhs are long stapled and the rest short stapled. About 35 lakhs of bales, mostly short stapled, are exported and about one half of this quantity is purchased by Japan. It may thus be stated that Japan buys about one third of India's total cotton crop and about one half of her total exports. Japan thus occupies an important position in Indian cotton markets. This is further borne out by the fact that the passing of the boycott resolution of the Japanese had almost a psychological effect on the cotton markets and depressed prices by about Rs. 15-per *khandi* in spite of the fact that the Japanese were still buying in the market to fulfil old contracts. If the Japanese were to withdraw from the Indian markets it would undoubtedly throw the whole trade into confusion, at any rate, till conditions adjust themselves afresh. It is calculated that the minimum total loss which the Indian cotton grower would be put to will be in the neighbourhood of about 8 crores of rupees. Should it happen this will be a great calamity to a large section of the cotton growers and will have serious repurcussions in the finances of the country.

This however should not blind us to the serious consequences to the countries industries arising from the cut throat competition of the Japanese manufacturers. Japan's trade with India has of late been increasing by leaps and bounds. In 1930 Japan occupied the second place amongst the countries having trade relations with India, the first being the United Kingdom.

70 per cent of her exports to India consist of textiles and the rediculously low prices at which these are sold in the country constitute a serious menace to the Indian mill and Handloom industry. Between 1916 and 1930 Japanese imports of textiles into India have increased seven fold. In proportion to the increasing imports from Japan the Indian textile industry has been growing shaky. Most of the mills are running at a loss and a number of them had to close down being unable to clear their stocks. It is not only cotton piece goods that is subject to this severe competition, but all kinds of textiles and knitted material, silk, artificial silk, hosiery, toys, glass bangles, boots, shoes and a host of other things. Japanese industrial methods and competition is causing serious dislocation of trade all the world over including England and America, the very home of modern industrialism.

The country is thus placed between the horns of a dilemma. Either protect the infant industries of the country from the inroads of the Japanese competition and inconvenience the cotton grower, or stand by the latter by pleasing the Japanese and irrevocably ruin the industries of the country. It is hoped that the forthcoming conference at Simla of the Indian, Japanese and Lancashire representatives would bring forth some solution acceptable to all the three parties concerned. But the greater interests of India should not be sacrificed to please any particular party or section. The need for protecting the industries of India from the inroads of Japan is undoubtedly great. The loss to the farmers if Japan withdraws from the market has been estimated at about 8 crores of rupees. But the loss to the country's industries if Japan is allowed to complete unrestricted would be several fold more. The textile industry (both the mill and the hand loom industry) and several other industries will be simply wiped out of existence in a short time.

Taking every thing into consideration one is led to think

that the importance of the Japanese market for our cotton is exaggerated. Japan, as a buyer, has appeared in the Indian markets only recently. Indian cotton had a market even before. If Japan now suddenly withdraws from the Indian market it will undoubtedly produce serious dislocation of trade, but it will only be for a short time and conditions will adjust themselves later. It is certainly possible to explore other openings for our cottons. It is quite likely that the consumption of Indian cotton in Lancashire will increase considerably in the near future. The Committee appointed by the board of Trade (according to the Ottawa Agreement) to explore the possibilities of increasing the use of Indian cotton in Lancashire is quite pleased with the results of their trial. About 87 varieties of cloths including some of the standard cloth, made from Indian cotton were recently exhibited in the buildings of the Manchester Chamber of Commerce. The use of Indian cotton in the continent has been increasing of late. It is also possible to substantially increase the use of our cotton in Indian mills.

Thus if Japan boycotts Indian cotton the consequences need not be so catastrophic as is often made out. On the other hand our infant industries will be completely ruined if Japan is allowed to compete freely in the Indian Market. The Japanese boycott threat, however, serves as an eye opener to the unsound basis of our cotton production. India has a vast market for cotton cloth and next to the U. S. A. she is the biggest producer of cotton. Much of the land under cotton in India is now producing for meeting the demands of a foreign market, while for the use of our own mills we are importing vast quantities of cotton from America, Egypt and Africa. In addition we also import annually cotton piece goods worth about 50 to 60 crores of rupees. The Japanese boycott threat brings into prominence the need for remedying this state of affairs. Cannot India with her vast agriculture and cheap labour

produce all the cotton she needs and manufacture all the cotton she produces? Why depend upon a foreign market for our raw materials when we have ourselves an enormous home market?

ADDRESS
GIVEN BY THE PRINCIPAL, AGRICULTURAL COLLEGE AT THE OPENING OF THE NEW TERM

Students, I welcome you back to the Agricultural college at the beginning of a new session and I hope the vacation has given you that rest which I am sure you all felt you deserved after your strenous last term and I also hope you have managed to store up a quantity of energy sufficiently great to carry you through the coming year of what I hope will be hard but pleasant work.

The beginning of a new term or year is usually a time when nearly every one makes resolutions and determinations to do certain things or to avoid doing others. I have no doubt that each of you has made up his mind to maintain the good place you obtained in your class last year, if you did have a good place, or if you did not, to better the place you did get. I am sure you have all returned imbued with the one desire to do well in the coming year by working hard and concentrating on your work and by eschewing those things which you know frittered away your time last year and made you take a more lowly place in your class than you feel and know you should have. The making of resolutions is easy but carrying them out is a different matter. A cynic once said that the road to Hell is paved with good resolutions which of course, means that the good resolutions are seldom carried into effect. I hope none of you will help to make the road to Hell any easier by adding to the already large accumulation of broken resolutions. Make up your minds to carry your good resolutions into practice and help to pave the way to the formation of a strong character, for character is what education is meant to develop and if

you do that, not only will you add lustre to your own name, but you will add glory to your parents, your school, your College, your province and your country. Remember that it is not only the results of examinations that are taken into consideration when deciding whether a student has done well at school or college. His character, his behaviour, his aptitude, his applicability are even more important. What Indian agriculture wants, more than anything else, are enthusiasts plenty of them, men with but a single thought viz., to raise the standard of agriculture in the country and give the cultivator a better and more remunerative return for his labour.

Those of you who are hoping to obtain service under Government at the end of your college course must bear in mind that the available posts are few and far between and they will be filled only by the very best men. Competition nowadays is so great that no employer need take a man of mediocre abilities when there are plenty available with much better qualifications. I have recently had a large number of applications for posts in the Department from new B. Ag.s., many of whom seemed to be quite sure of employment but who have not the ghost of a chance because much better men have applied for the few posts now vacant. These men are sorry now they did not apply themselves more vigorously and intensely to their studies when they were at college. They were merely cases of good resolutions gone bad. I want each of you to keep in mind during the coming years of your college careers that it is very nice to have a good time, but do not forget to reckon the cost and blame nobody but yourself if you find yourself at the end with a third division pass instead of a first division.

I wish to congratulate the students of the 2nd year for doing so well in the Intermediate examination and particularly the three students who obtained 1st class viz., K. G. Joshi, V. G. Vaidya and Biswanath Sahu. Mr. K. G. Joshi deserves special praise for winning the Sir Arthur Blennerhassett silver medal for standing first in the Intermediate Examination. I hope the other members of the class will try to emulate these three students and when their turn for the B.Ag. examination comes round that there will be a large number of 1st class passes.

In the promotion examination held last year practically everyone passed, though several students obtained compartmental but the fresh

examination, I am glad to say, did not prove a stumbling block except in one instance.

Well, students, I do not mean to keep you any longer. This is my introduction to you. I meet you for the first time and you meet me for the first time. I am sure our association will be pleasant and I sincerely hope so. I do not think we shall be bothered again with the fever which necessitated the closing of the College two years ago. I hope not, for, there is no time in the life of a student for anything but study, when he has passed all his examinations he can spend the rest of his life in politics if he wishes to, but while he is still a fledgling he should be concentrating on learning to fly, in preparation for the serious affairs of life viz., the acquisition of food.

I wish you all the best of good luck during your remaining years here and I hope your stay at the College will be such that you will be able to look back to it in the years to come with feelings of happiness, nothing but gratitude. I hope also you will all be blessed with good health and that your relations with your teachers will always be pleasant.

In conclusion I want to remind you that each of you is master of his own destiny and that you are now laying the foundations of your future life. See to it that these foundations are sound and well and timely laid for however elaborate and grand the superstructure may be, it cannot last long and be of much value if the foundations are faulty.

Original Articles

COTTAGE INDUSTRIES IN C. P. & BERAR

BY P. SUBBA RAO

General Introduction.—In these days of advanced industrialism it is difficult for many to believe that cottage industries can exist at all, and much less, add to the wealth of any nation. In India, however, the cottage industries have shown a wonderful power of resistence and these industries constitute even today the principal, and in some cases subsidiary, occupation to several millions of people. The climate and the customs and manners of the people of India are all in favour of the cottage type of industries. The needs of the people are very few, and the small income derived from the sale of finished articles is for many the only means of livlihood.

There are still many potentialities in cottage industries and quite a number of them are capable of considerable improvement. Some existing cottage industries such as hand-loom weaving, brass and bell-metal work calico printing and gold and silversmiths' craft hold their own against cheap machine made articles turned out from large scale factories. This is due entirely to the artistic merit of the hand wrought cottage product and not to any sense of patriotism in the Indian consumer. It has often been asserted by many that cottage industries cannot survive for long in the face of competition from factories, but this does not appear to be true, as many cottage industries do still continue to exist and appear to be flourishing in spite of continued inattention and want of organization.

Most of the important cottage industries of this province are practised by the agricultural classes, either as principal or part time occupations. There are several other handicrafts capable of being taken up by agriculturists as spare time occupations. It may be asked, why then the agriculturists remain without work for some months every year. The only answer is, that it is due to his own ignorance and lack of an earnest and organized effort on the part of those interested in his well being. It is necessary the agriculturist should be shown the best method of practising some suitable cottage industry by the propagandist, who should also be thoroughly conversant with the local

needs. He should suggest such industries as could readily be taken up by the people, and whose finished products will be readily sold in that locality. It is therefore necessary that the propagandists and students of rural economics are kept informed about a few important and promising cottage industries of this province. A series of articles on such industries will be published in this journal for the information of those interested in the development of cottage industries in this province. These articles will deal with the present position of each cottage industry and the modifications necessary for its adoption by non-professionals and will also attempt to give some practical suggestions for their improvements.

1. HAND-LOOM WEAVING

Extent of the Industry:—The hand-loom weaving industry is the most important cottage industry of this province. In 1930-31 there were 97,437 hand-looms working in this province producing cloth of several varieties and descriptions. They used approximately 2,34,820 mds. of yarn and produced approximately 2,62,998 mds. of cloth representing 41.7 per cent of the total of 6,29,188 mds. of cloth consumed in this province. A little more than a quarter of the yarn consumed by the hand-loom weavers is produced by the mills of this province, the balance is imported and mostly foreign. The total number of hand-looms in this province has been given as 97,437. Each loom provides employment for three adult members including women. The number of persons including women and children supported by the earnings from a loom is usually five. According to this, the total population supported by the hand-loom weaving industry of this province is 4,87,185 as against the 20,446 operatives employed in the 12 mills of the Central Provinces and Berar in 1931.

The demand for hand-loom cloth is at its best during marriage season and festivals. When the demand for cloth is brisk a weaver can produce as many as 25 *sarees* a month of 32s x 16s yarn. This rate of production represents the maximum capacity of a hand-loom, but to be on the safe side 20 pieces of cloth per month may be taken as the average for medium and coarse counts of cloth. On the above basis the maximum quantity of cloth that could be woven by hand-loom weavers would be 4,71,662 mds. per annum and this is reported to have been the average production per annum during the boom period ten years ago. This has fallen considerably of late and during the year

ending 1930-31 the hand-loom weavers of C. P. and Berar produced only 2,62,998 mds. of cloth.

The Hand-loom and Mill Production:—The hand-loom weaver has several advantages over the mill. On account of the very highly machanized condition of the factories their production is standardised and they can only produce a very few varieties. The hand-loom weaver on the other hand can change his patterns at will and produce cloth to suit the changing whims and fancies of the consumers at short notice. In addition, his product is artistic and more durable. The hand-loom weaver can also cater to the peculiar tastes of a particular locality which the mass production methods of a factory cannot take into consideration.

Coming to the question of comparative costs between mills and hand-loom production, the average sale price per lb. of cloth in a mill is about the 1-8-6, and that of a lb. of yarn is 1-3-0. The hand-loom weaver buys the yarn from the mills and assuming that he sells the cloth at the same rate, his wages will be about 0-11-0 per day. This is a fairly decent wage for an artisan of his type. But the hand-loom weaver's product is of a type for which there is no competition from the mills, and sells at a higher price. Thus his wages are even more than the figure indicated.

Now the fear is often expressed, that the hand-loom weaver will be completely annihilated by the growing mill industry in India. This fear, however, is absolutely unfounded. It is almost impossible to imagine a time when the whole requirements of the consumers in India will be completely met by the mills. There is always bound to be a demand for particular kinds of *sarees*, *Dhoties*, *Uparnas* and the like which the mills can never produce. These afford the hand-loom weaver an almost exclusive market where his position is certainly unassailable.

The hand-loom weaver's equipment for manufacturing cloth is very simple and consists only of the most essential tools for his work. A wooden loom supported on four posts, and the yarn stretched about a foot above the ground, this is how the weaver usually produces his cloth in this province. The weaver is helped by the other members of the family in the preliminary processes, while the principal earning member devotes his attention to such important items of work as the final manufacture of cloth and its sale.

During recent years the attention of the department of industries has been occupied in devising ways and means for improving the

weaver's economic condition. With this end in view some improved appliances have been devised and introduced into the weaver's house. The hand-loom weaver, like every other village artisan, is averse to adopt improvements readily. In spite of this conservatism on the part of the weaver, a little over a quarter of the old time honourned hand-looms have already been replaced by the improved fly-shuttle looms. In addition some warping machines were also introduced. The fly-shuttle looms alone have increased the output of the weaver by 50%, and his income by about 25%. The weavers do not go to any distant market but try to sell their product in their own locality, where the demand for any kind of cloth is limited. As the fly-shuttle increases the output the weaver finds it difficult to sell the cloth in his own locality with the result that the prices realized for his output are less, and some weavers are not producing to their maximum capacity. The question of changing the pattern for some more popular and paying kind of cloth is engaging the attention of the Department of Industries and a certain amount of success in this direction has already been achieved in a few localities.

A co-operative organisation to supply raw material and to collect and sell the finished products of the weavers in every important centre will go a long way to put the industry on a satisfactory basis.

Hand-loom weaving is generally practised in this province by the weaver caste. But there is nothing to prevent others from taking it up either as a main or subsidiary profession. There are several instances in India of non-weaver caste people taking up weaving as a profession very successfully. Spinning and weaving was a traditional occupation in most Indian homes till very recently and it will not be very difficult to popularise this industry as a subsidiary occupation amongst the agriculturists who have a certain amount of leisure at their disposal during most parts of the year.

(To be continued.)

A FEW HINTS ON THE PRUNING OF FRUIT TREES

BY N. K. DAS, L.AG. (HONS.)

In this article it is proposed to give a few general hints on the practice of pruning in so far as it relates to fruit trees. Some of these hints will, however, be found applicable to other kind of trees as well.

The season of the year during which a tree is pruned has an

important bearing on its health and future development. All fruit trees pass alternately through the two phases of active growth and rest. In the case of evergreens there may be several periods of active growth in a year while in the case of deciduous fruit trees there is usually only one such period. Unusual growth, or a check to the usual growth may be induced by sudden changes in weather conditions but these are exceptions rather than rules. Important changes occur during the growing and the resting period in the amount of elaborated plant-food found in the roots and stems. During the period of active growth the top of the tree contains large quantities of such food while during the dormant period much of it is translocated to the lower parts. In the case of deciduous trees the dormant period is quite well marked and is characterised by the fall of leaves. In the case of evergreens there is no wholesale loss of leaves at any time of the year, but the difference between the growing and the resting period is perceptible even to a casual observer. The bearing of these facts on pruning is, that if too much growth is removed from a tree during the active period of its life it will be deprived of much of the stored up food and the tree may consequently suffer. Considerable reduction of the foliage during the growing period of a tree also tells unfavourably upon its capacity to manufacture food. As a general rule it may therefore be laid down that all thinning out of branches should be done during the resting or dormant period. It is sometimes necessary to head back the old unhealthy branches of fruit trees in order to produce new healthy limbs. When such necessity arises the heading back should also be done during the period of rest, the object being to remove as little plant-food as possible. A certain amount of pruning during the growing period, if judiciously done, may prove helpful in building up the head of a tree. The young shoots and water-sprouts which start growing at evidently undesirable situations—shoots that will require removal sometime or other—may be prunned off during this period, so that whatever stored food there is in the tree may not be wasted in useless growth.

Fruit trees require different pruning treatments at different ages. The first few years in the life of a tree constitute what is known as the formative or body-building period. This is followed by a period of transition during which it gradually developes the habit of bearing fruits. Then comes the fruiting period or the period of commercial usefulness. During the formative period the tree spends its energies only in making a vegetative growth out of which the framework for the

future head of the tree has to be built up. Proper attention paid to the tree during this time saves much labour and waste of material. The transition period extends over the next few years. During this period vigorous vegetative growth has to be discouraged, because such growth is incompatible with a regular fruit-bearing habit. When the tree has definitely entered into the third period of its life, that is, when fruiting has become an established habit, its vegetative growth naturally slows down. It is therefore evident that a fruit tree that has been carefully trained during its earlier years will require the least amount of pruning during this period.

In pruning a young fruit tree, the main object is, as already indicated, to build up a suitable framework for the top of the tree. Consequently, it is necessary for the grower to decide early what type of head the tree should have. According to the position of the framework or scaffold branches on the main trunk, there are three types of head that fruit trees may have, namely, (1) the central leader (2) the vase-shaped, and (3) the modified central leader. Each of these types can be produced to perfection only by careful pruning.

The central leader is the type of head that a tree left to itself will often develop. The main trunk takes the lead in growth and sends forth side branches. In building up such a head for a fruit tree it is necessary (a) to keep the branches distributed spirally on the main trunk so that there may be balanced growth on all sides and (b) to provide a sufficient vertical distance between the consecutive branches so that compound crotches may not be developed. Crotches formed by many branches springing from a short region on the main trunk are likely to split under a heavy load of fruits or when high winds blow with disastrous result to the tree as a whole. It is also necessary to see that the laterals do not make very acute angles with the main trunk, since such angles also tend to produce weak crotches by bark inclusion.

The vase-shaped tree is just the opposite of the central leader tree. Its framework consists of a few branches of equal growth spreading on all sides from the main trunk so as to give to the tree the shape of a vase. About three or four such branches may ordinarily be regarded as sufficient. These may be selected from among the laterals that naturally appear on the main trunk or from among those that may be forced to develop by heading back the primary axis. In

either case, however, the primary axis has to be prevented from making a vertically upward growth. No one branch of the framework is allowed to outgrow the others in which case the tree would become ill-balanced. In the vase shaped tree a compound crotch is almost unavoidable, since the framework branches are not separated by any appreciable distance along the main trunk.

The modified central leader is a compromise between the two types mentioned above. To start with, the main trunk in this case has the ascendency. Laterals are allowed to grow on it as in the case of the central leader tree. The vertical separation of the primary branches along the main axis is quite appreciable. After a few years the leader is suppressed so that it no longer continues to be prominent.

Each of the three types of trees has its advantage and disadvantages. The vase-shaped tree can be easily kept low-headed. Hence it affords considerable facility for spraying, pruning and picking of fruits. On the other hand such a tree is weak in structure on account of its compound crotch, and is likely to split. Splitting of the main branches, more often than not, ruins the tree itself. The central leader tree is structurally stronger and there is less breakage. Even when there is any breakage the tree as a whole is not affected. The one great disadvantage of this type, however, is that the tree cannot be kept low-headed. Consequently its management involves much labour and expense. In the modified leader tree this disadvantage is considerably eliminated, while the advantages of the vase-shaped tree are to a great extent retained.

A certain amount of judgment is necessary in choosing the type of head that a fruit tree should have. It will be improper to choose the central leader type for a naturally tall-growing tree, as it will only add to the disadvantages experienced in its management. In case of a tree that does not make a considerable vertical growth, this type will not, however, prove so disadvantageous and may even be desirable.

The head of a tree may be built up at any height according as the grower desires. But a vase-shaped head on a clean tall trunk is hardly desirable and is rarely attempted by any intelligent fruit-grower. Since low-headed trees are easier to manage it is not desirable to have high-headed trees in commercial orchards. The exact height at which the head of a tree should be started depends to some extent

on its habit of growth—a naturally erect-growing tree being headed comparatively lower than one of a spreading or drooping habit.

Any of the three types of heads mentioned above may be made open or bushy as the grower desires. But any decision in this respect has to be made with reference to the kind of the tree as well as the climatic conditions prevailing in the locality. It is ordinarily desirable to train a naturally erect-growing and compact tree in such a manner that the branches may spread outward to some extent. Again a naturally spreading or drooping tree is generally trained so as to produce a somewhat compact or busy head. These objects can be achieved by choosing for the framework only such branches as make the most suitable angles with the main trunk and by heading back the branches to outside or inside buds as need be. Wide angles between the scaffold branches and the trunk will tend to produce a somewhat spreading or open head, and narrow angles a compact or bushy head. When the branches are cut back to outside buds the latter in course of time produce shoots that grow outward with the result that the head tends to become open. When on the other hand, the branches are cut back to inside buds the result is a somewhat compact head. It is, however, important to bear in mind that any attempt to bring about a considerable deviation from the natural habit of growth is not likely to be attended with success and would often mean considerable waste. The fruit-grower should be thoroughly acquainted with the material he has to handle.

As regards the bearing of climatic conditions on the pruning of fruit trees, it is to be borne in mind that when it is necessary to afford protection to the trunk, branches or fruits against the intense heat of the sun it is desirable to have a bushy head; if free admission of light and air is intended, so as to secure proper colouring of the fruits a comparatively open head has to be built up. It would not be advisable, for instance, to thin out the branches of an orange tree at Nagpur to the same extent as may be desirable for an orange tree at Shillong.

During the transition period, that is, the period during which the fruit tree is expected to pass from the growing to the fruit-bearing stage, the pruning should be naturally somewhat restricted. The fruit-grower should be able to distinguish, where such distinction exists, between the fruiting branches and the purely vegetative growth.

As a general rule excessive vegetative growth should be suppressed during this period and the development of fruiting branches encouraged. All water-sprouts or suckers, unless required for filling up gaps, should be removed, and even when any of them have to be left, they should be headed back so as to cause branching and consequently a slow circulation of sap which induces fruiting. Succulent new growth may be removed or shortened to advantage during the growing period. Fruit trees differ from one another in their mode of bearing. The orange bears fruits on short slender branches or current year's growth, known as fruiting brushes; the mango does so on old as well as new growth; the apple and the pear produce fruits on much reduced branches called spurs or fruit spurs. It is therefore important to bear in mind that the pruning of a fruit tree without due regard to its mode of fruiting may eventually put off the period of its commercial usefulness and if it is continued year after year, fruiting may never become an established habit with the tree.

During the third period, that is, when fruit-bearing has become a regular habit, very few fruit trees will continue to make a vigorous vegetative growth, except probably when they are stimulated by heavy dressings of nitrogenous manures or by heavy pruning. Generally speaking, the pruning during this period should consist merely in removing dead or dying limbs and crossings or superfluous branches. Water-sprouts or suckers springing from dormant buds should also be cut off. These rob the tree of its food and do not bear fruits until they are several years old.

It should be recognized by every one who has to do with the pruning of fruit trees that there is a balance between the roots and the branches. Heavy pruning of the top seriously disturbs this balance and the tree in its attempt to regain it generally makes a vigorous vegetative growth. This is specially the case when the pruning is done during the dormant season, the reason being probably that more plant-food is left in the remaining parts after a dormant season pruning than after a pruning during the growing period. As already said, vigorous vegetative growth and heavy cropping cannot go hand in hand. It therefore follows that the bearing habit of a fruit tree may be seriously affected by injudicious heavy pruning of the top. On the other hand, if a fruit tree continues to make excessive vegetative growth at an age when it should yield regular crops a certain amount of root-pruning will invariably bring about a change in its habit by reducing the supply of food from the soil. An important point to remember in this connection is that, as a

result of vigorous vegetative growth, a heavily pruned tree does not necessarily gain more in weight than a lightly pruned or unpruned tree. The opposite is rather true. Vigour has reference only to the condition and not to the size or total weight of the tree.

Pruning of fruit trees, to be really beneficial and least harmful, should be a regular practice. If it is done only once in several years, there is considerable waste of material besides the danger of unfavourably affecting the fruit-bearing habit of mature trees. Another effect of such pruning is that it involves the cutting off of big branches and thus making large wounds. These wounds either never heal up completely or take a long time to do so. The trees therefore remain exposed to infection of diseases for a long time. The writer has under his management an orchard of apples, pears, peaches, plums and other deciduous fruits which had to be pruned somewhat heavily in 1931-32. The large wounds that were made did not heal up completely during the following growing season and some of them did not show any signs of healing at all. Moreover some apple trees were lost and some had to be badly amputated on account of fungus diseases getting a foot-hold in the wounds.

Since the pruning of trees often involves the heading back of branches the fruit grower should be acquainted with the behaviour of buds on branches so treated. The responses of buds on headed back branches may not be quite identical in all cases, but it may be safely laid down as a general rule, that the heading back of a branch usually has the effect of pushing the lateral buds into growth—the shoots near the top growing more vigorously than those occupying lower positions. Suppression of some of the shoots near the top may however lead to a more concordant growth of the lower shoots.

The effect of removing lateral branches from the trunk or any branch of a tree is to retard its stockiness. This should be borne in mind in securing balance among the different limbs of a tree.

When a branch has to be removed it should be detached by a clean-cut. No stub should be left. Usually a secateur is used for removing small branches and a saw for big ones. In either case it is necessary to see that a smooth wound, and not a rough or lacerated one, is left on the tree. A pen-knife with a strong blade may be used for trimming the edges of the wound. A clean-cut wound heals up

more readily than a rough or lacerated one. Wounds made immediately before or during the growing season heal up more quickly than those made during the resting period. Various dressings are recommended for protecting the wounds against diseases. Of these, coal-tar is the one most commonly used. Coal-tar, however, is said to contain certain injurious substances but most of these being volatile, can be got rid of by boiling. Since wound dressings often retard the healing process small wounds not exceeding an inch in diameter may be left without any dressing. Large wounds, should, however, be invariably painted with a protective dressing.

In pruning, one has to be careful about the manner in which one handles one's tools. Branches that are too big to be removed with a secateur and would require the use of a saw for the purpose, should usually be cut from the underside. If the opposite procedure is adopted the branch that is removed often brings with it a slip of bark from the trunk or the limb from which it originated. In dealing with a heavy branch, its weight should be first reduced by cutting it at some distance from the point where the final cut is to be made, and then the usual procedure should be adopted. When the branch is very thick it is difficult to work the saw right across the branch if the cut is commenced from the underside. In that case the cut from the underside should be made only up to a depth of one-third the diameter of the branch and then a second cut should be made from the upper side, a few inches above the first, right across the branch so as to detach it completely from the tree. Injury to the bark of the tree will be prevented by the lower cut. The stub that will be left can easily be removed afterwards.

There are so many different types of pruning saws on the market that it seems necessary to make a brief reference to the relative merits of some of them. The writer has handled several types but has found only two that he can recommend for general use—one with a long narrow blade with teeth of medium size and the other having a comparatively broad and curved blade with somewhat coarse teeth. The double-edged saw is very inconvenient to use. It injures branches which it is not desired to remove and sometimes also injures the man who uses it unless he is constantly on his guard against such injury.

Before closing this article, it should be pointed out that the hints given in this article are at best only general and broad. Any one having to do with the training of fruit-trees will frequently be faced

with problems not dealt with in this paper. The points discussed will however, serve to show that pruning is an art which cannot be practised in a haphazard manner; and that it can be done rightly or wrongly, to the benefit or detriment of fruit trees, in respect of both beauty of form as well as productive capacity.

THE EFFECT OF THE DEVELOPMENT OF COMMUNICATIONS UPON AGRICULTURAL PRACTICE AND PROSPERITY IN INDIA*

By G. C. Baruah

Importance of Communications:—By far the most important achievement of man in altering the natural environment is to be seen in his success in overcoming the influences of location. This has been effected through improvement in the methods of transportation and communication. Changes in transportation facilities are largely responsible for the growth and decline of cities, sections and nations. Prosperity and communication go hand in hand. With every shifting of trade routes communities advance and recede. A good system of communications by land, water and by air is one of the most important of all the requisites for the prosperity of a nation. It breaks down the isolation of the different part of the country and brings them into an organic relationship with one another. It enables a country to utilize its economic resources to the best possible advantage. Throughout the whole history of India difficulties of communication have been a predominent factor in determining political and economic development. At the present time, due to the development of communication one country can rule another from a great distance. Transportation is an integral part of marketing, and modern commercial development tends everywhere to enhance the value and importance of good communications. Improvement in transport and communication also includes the transmission of power, e. g., transmission of electricity from water falls and sea water for industrial purposes, Hydro-electric works, and the communications of intelligence such as the post, the telegraph, telephone and wireless. Roads and railways have revolutionized the method of transport causing pack animals to be almost entirely displaced by wheeled vehicles. In the past the commerce of the different countries was

* The best class essay on the subject written by the Senior B. Ag. Students.

chiefly dependent on animals for transport. At the present time it is only where railways have not penetrated that packed transports have preserved any important share of long distance traffic, though in sandy or hilly tracts a considerable amount of local traffic is still dependent on this means of conveyance. Only very lately the idea of steam as a propelling power was scoffed at. When Solomon de Cause first advanced the idea of employing steam as a propelling power in 1615, he was shut up in the mad house as a hopeless maniac. Two centuries later in 1812 when Col. Stevens proposed to build a steam railway he was regarded as absurdly visionary and somewhat demented. And yet today almost within the short space of a human life we have a vast network of over half a million miles of iron roads encircling the civilized world, considerably over 1/14 (38,579 miles) of which are found in such a backward country as India.

Communications and the Cultivator:—Good communications are of great importance to the cultivator, for on them largely depend his opportunity for the efficient marketing of his produce. Good communications, in combination with efficient marketing arrangements, enables produce to be moved cheaply and quickly to places where the demand for it is active, and secure the equalisation of prices for particular classes of produce throughout the country; and both these factors react favourably on the price which the average cultivator receives. It brings the agriculturists in touch with the markets of the world and that helps to give a higher price for the commodities. Good communications also raise the prices of the commodities in general. It is the improvement in communications since the middle of the last century that more than any other factor, has brought about the change from subsistence farming to the growing of money crops such as cotton, jute and other oil seeds. The improvement in communications has equalised prices in the case of agricultural produce within reasonable distance from a railway and it has also made the imports available at a cheaper rate than before.

Communications bring people into the centres of civilization. It is said that Indian civilization had its origin in the forests. But at the present time towns and big cities are the centres of civilization, villages are in isolation and cut off from the rest of the world. New ideas, new discoveries and new thoughts come into existence in big cities and towns and if there is no communication these cannot go from

place to place and hence no improvement. Good communication tends to specialization of production or concentration of production. It creates new employment and makes possible a more even distribution of the people. The rapid industrialisation of the country largely hinges on a satisfactory railway development facilitating the transport of coal and raw materials as well as the distribution of finished goods. Railway transport facilities and the demand for railway sleepers have greatly encouraged timber growing.

The condition of communications in India:—(1) **Roads**—Before the advent of the British rule roadways in the modern sense were practically unknown. The level plains of India scoured by streams which for eight months or more in each year are passable without difficulty by the conveyances generally used in the country, offer so small an obstacle to intercourse between different localities that up to the end of the 18th century, there was no demand for prepared tracks, transports being chiefly carried on by pack animals travelling along the village pathways, while travellers could ride or be conveyed in palanquins or bullock carts. The Moguls, however built several military roads such as the road leading west and north through the Punjab into Afghanistan and Kashmir—the present grand trunk road and the road to the south through Gwalior and Ujjain to Birhanpur and Surat and thence to Golconda and the Deccan. The main roads of India built after the advent of the British are generally good although those connecting the small towns and villages are still unmetalled. The condition of the roads in India has deteriorated in recent years and the rapid expansion of motor traffic has brought into existence an entirely new range of problems of road construction and maintenance. This new factor has led to the recent appointment by the Government of India of a road development committee, consisting of 14 members of the central legislatures which has investigated the whole question of road development in India. The concern of this committee was primarily with the development of main roads, but the Royal Commission on Agriculture has suggested and emphasised the importance of subsidiary communications which are of even greater concern to the cultivators. Road boards have been established in some provinces, but their functions are in the main advisory and it is only in the Punjab and Burma that they have wider functions and have embarked upon an ordered programme of road development. The main roads are always receiving a disproportionate amount of attention than the subsidiary roads. This of course is

unfortunate, and care should be taken by the Local Government to improve the village roads.

Railways:—The history of Indian railways very closely reflects the financial vicissitudes of the country. The railway building in India on any extensive scale dates from Lord Dalhousi's great minute of 1853. Gradually railway expansion proceeded in India. At the present time there are about 38,579 miles of railways open for traffic in India. The great railway systems run inland from the chief ports and by far the greater part of the Indian railway system is now owned by Government. The economic effects of railways are most important to India and the following are some of the advantages of the introduction of railways in India. (1) The pilgrimages which play such an important part all over India in the daily life of the population and which formerly occupied months and absorbed the saving of life time, now involve comparatively a trifling cost and an absence from home of only a few days. (2) The cheap, easy and quick communications enable the surplus population in conjested areas to move to the more parsely populated part of the country where labour alone is needed to make the soil yield bountiful harvests. (3) The improvement in communications has equalised prices in the case of agricultural produce within reasonable distance from a railway and it has also made the imports available at a cheaper rate than before. (4) It has made modern development of manufactures possible by making coal and other requisites cheap. (5) The value of railways as a means of preventing the ravages famine is great. Food grains can now be easily and quickly transported to districts affected by famine from districts where there is an abundant harvest, so that famine no longer means scarcity of food but only scarcity of money which is always less difficult to meet. Besides railways enable people to leave the affected places for a time and go elsewhere to find work and food. (6) The railways are weakening caste prejudices. (7) It gives employment to a large number of people.

There are, however, some Indian economists who do not look upon the extension of railways as an unmixed blessing. From the above it should not be inferred that we regard the present state of communications as satisfactory. Inspite of the developments of the last half century, this is very far from being the case and India must still be regarded as a backward country in respect both of railways and roads. India occupies a humble position, if a comparison is made

between the milage of railways per head of population in this and other countries.

Canals:—Importance of canals as a means of communication is paramount in India though not so in Europe. In a land of villages, where agriculture is the chief occupation of the people the importance of canals as a means of communication and transport cannot be too much exaggerated. But unfortunately they are sitting up everywhere specially so, as the pressure of population in increasing daily on land and the mother canal are being damned to reclaim every inch of land available for cultivation. Canals are high water ways in India in as much as they are links between rivers or between rivers and sea. The utility of rivers will be greatly increased by the construction of navigable canals.

In conclusion, it may be said that good communication is the very life and soul of trade and it acts as a stimulus both to agriculture and to industry. Without good communication agricultural products will have no good market and hence no improvement in agricultural practice is possible. In short, the prosperity of India and improvement of agricultural practice depend solely on the development of communication facilities.

Selected Articles

THE MINERALS IN MILK

By. Dr. J. A. Tobey, P.H.

Consumers of milk recognize that it is a valuable food but they seldom realize that it is a natural source of at least 25 different minerals. Those persons who can claim some familiarity with the modern science of nutrition may know that milk is our best dietary source of the important lime salts, or calcium phosphates, and they may be aware that it supplies several other desirable minerals, but even these *cognoscenti* may be surprised to learn that milk also contains lithium, strontium, vanadium, rubidium, titanium and germanium, all rare elements.

Although milk solids comprise only one-eighth of the volume of cow's milk and the minerals constitute only a little less than I percent

of its total bulk, the average milk supply customarily possesses nearly one-third of all the known chemical elements. None of the many minerals in milk is visible because all are in solution or suspension, usually in various combinations with organic or inorganic substances. Some of these minerals are relatively abundant, while others are present in such small quantities that only unmeasurable traces of them can be detected by chemical analysis.

The minerals of milk are separated from it by incineration at a low red heat. At the end of this process there remains a white ash which shows an alkaline reaction. About one-eighth of this ash is calcium, a little more than an eighth is potassium, one-tenth is phosphorus, another tenth plus is chlorine, and about one-twentieth is sodium. The residue contains appreciable amounts of sulphur, magnesium and iron, in that order. Only traces are found of silicon, boron, and the group of minerals mentioned in the first paragraph above. Occasionally the analyst will encounter traces of barium, chromium, tin and silver in milk.

Since the minerals constitute only one percent or less of milk, the remainder of it is made up of organic compounds of hydrogen, oxygen, carbon and nitrogen, which form the butter-fat, proteins and lactose, or milk sugar. Sulphur and phosphorus are also repesented in the three principal proteins in milk, the nutritional functions of which are to replace and repair bodily tissue. Casein is the chief of these proteins, the other two being known as lactalbumin and lactoglobulin. Several others are also present but in exceedingly small amounts.

The various minerals found in cow's milk are, in general the same as those which occur in the human body. Our bodies are comprised of some 65 per cent oxygen, 18 per cent carbon, 10 per cent hydrogen, 3 per cent nitrogen, 1·5 per cent calcium and 1 per cent phosphorus. The remaining 1·5 per cent is made up of many different minerals, the functions of some of which are as yet unknown. The dietary duties of a number of the minerals in milk are also enigmatic, but they are probably in this food for a definite purpose.

Calcium and phosphorus are the most significant of the many minerals in milk, since these are the elements needed for the construction of the bones and teeth. If calcium is lacking in the diet of young children, growth is retarded. In cases of severe deprivation of this mineral and of the substances which cause it to deposit, a troublesome bone disease known as rickets will develop. Adults

likewise need a supply of calcium, although not as much as do children whose skeletal structures are in the formation. Pregnancy and lactation increase the need for calcium.

Scientific experiments have shown that not less than one gram of calcium or about half as much as there is in one front tooth, is required everyday by the growing body. Since cow's milk averages 0·12 per cent calcium, the minimum amount of this particular food needed to furnish the daily gram of the mineral is one quart, or 908 grams. The calcium in milk is, furthermore, in a form which permits of the most favourable storage in the body, for scientific investigations have demonstrated that this type of calcium is utilized more completely and efficiently than is the calcium that occurs in vegetables. The daily quart of milk has the advantage of supplying plenty of phosphorus, as well asprotein and the vitamins which are so essential to growth and good health. The body needs about twice as much phosphorous as calcium.

The activator of calcium is vitamin D. sometimes known as the sunshine vitamin, because the ultraviolet rays of sunlight acting on the skin or upon certain food fats will stimulate the formation of this, antirachitic vitamin. While milk contains some vitamin D, the quantity is not sufficient to prevent rickets. Dependance for an adequate quantity of vitamin D in the diet must, therefore, usually be placed upon other foods rich in this substance, such as cod-liver oil or eggyolk. The amount of vitamin D in milk may, however, be increased by scientific feeding of the cattle with irradiated yeast, or by irradiation of fluid or powdered milk. There are now on the market a number of vitamin D milks, the proper use of which will prevent and cure rickets. The milk furnishes the necessary lime salts, and the vitamin D causes proper deposition of these minerals in the bones.

Another attribute of the calcium in milk is its favourable effect upon the assimilation of iron. While milk contains only 0·00024 percent of this particular mineral, or a little over two milligrams to a quart, what there is of it is of exceptionally high food value. The body itself has only 0·004 percent iron and requires a daily intake of only from 6 to 16 milligrams, or about as much iron as would be equivalent in size to the head of a pin. The higher figure is necessary only when the calcium intake is deficient.

Modern research has proved that copper functions with iron in bringing about the assimilation of iron to form hæmoglobin in the blood. When there is a deficiency of hæmoglobin, the condition known as

anæmia results. Milk contains a small amount of copper about 0·27 milligrams in a quart. Compared to other foods, such as liver, nuts, legumes cereals the amount is slight. It is interesting to note, however, that a diet of whole wheat bread and milk supplies an adequate quantity of iron and copper for human nutrition. Such a combination is, in fact, a perfect diet from every nutritional standpoint, and will sustain life indefinitely.

With the exception of iodine, the amounts of the minerals in milk are more or less fixed and vary only slightly in content. There is some recent scientific evidence to indicate that the calcium and phosphorous in cow's milk may be slightly increased by irradiation of the cattle with carbon arc lamps, and that such milk will be more effective in preventing or curing rickets than ordinary milk. Although the content of certain vitamins in milk can be greatly increased by scientific feeding of cows, the important minerals in milk are, in general, not appreciably affected by such measures. The presence of some of the rare minerals may, nevertheless, be influenced by the chemical composition of the cow's rations.

Iodine can be increased in milk by feeding aliments containing iodine, such as kelp, to the cows producing the milk or by adding an iodine compound to the feed. Similarly the iodine content of milk supplies in different parts of the country will vary somewhat, according to the richness of the local feeds in this substance. Since iodine is important in nutrition because of its influence on the thyroid gland and as a preventive of goitre, proposals have been made for a deliberate increment of this mineral in milk. Medical authorities believe that such procedures may be helpful so long as the administration of iodized milk remains under the control of physicians familiar with individual cases, but they are sceptical as to the value of, and lack of harm from, shotgun methods.

Regarding the prophylaxis of goitre, the Journal of American Medical Association says "Milk doubtless can be useful in such endeavours, as can other food products. The mode of preference should be left the physician, however, and not to the food propagandist".

When milk is processed, as by pasteurization, condensing, or drying, it may acquire small quantities of metals from the apparatus employed. Thus, the drying of milk on steel rollers causes a slight increase in the iron content of the resulting milk powder, and the manufacture of evaporated or condensed milk, in large copper vacuum

pans may add tiny amounts of copper. Such increments are beneficial and not harmful, as the quantities are very small and the minerals involved are desirable. There is no evidence that canned milks acquire any appreciable amounts of metal from the containers in which they are packed. These canned milks are equivalent for all practical purposes to the best grades of pasteurized fluid milk.

Pure milk has long been recognized as the most important of the protective foods of mankind. Milk and green vegetables were given the appellation "protective" by Professor E. V. McCollum in 1918 because they provide ample amounts of calcium and vitamin A and thus serve to protect the body against the deficiencies of other common food stuffs. Fruits and eggs were subsequently admitted to the category of "protective foods" but no other single food can equal milk in general nutritional value. Milk is our most nearly perfect food, and not the least of its virtues is its exceptional content of desirable mineral substances (*Scientific American. July 1933).*

Extracts

SALINE AND ALKALINE SOIL*

A Summary of some results of recent researches on their origin, genesis and agricultural relationships.

BY F. HARDY

I. Distribution:—Saline and alkaline soils are widely distributed in the arid tropics and sub-tropics. They occur wide-spread but are somewhat localised in the South-Western United States of America; Mexico; the Pacific slopes of South America; the western parts of Brazil and Argentine; North and South West Africa (Sahara, Egypt, Sudan, Kalahari); Central and South Western Asia (Arabia, Iraq, Persia, Palestine, Afghanistan, Baluchistan and Turkestan), the *reh* lands of India (Rajputana and Punjab); Central and Western Australia and in numerous smaller areas in other parts of the world, including certain West Indies Islands (Cuba, Haiti, Puerto Rico, Jamaica, St. Croix and

* Tropical Agriculture, Vol. X, No. 2, February 1933.

Antigua). Their reclamation offers some of the most difficult problems that agriculturists have to face.

II. Classification, chief features and inter-relationships :—The researches of Russian pedologists have led to the recognition of three main classes of arid soils, namely (*a*) Solontshak (saline soils; " White alkali " soils), (*b*) Solonetz; (alkaline soils; "black alkali " soils), and (*c*) Soloti (degraded alkaline soils). A fourth group (*d*) Rendzinas may be added to include alkaline non-saline soils rich in calcium carbonate.

(a) **Solontshak** :—This title is given to soils that contain large amounts of common salt (sodium chloride), whose presence may be attributed to inundation by sea-water, to decomposition of soda-bearing minerals, or to infiltration from strata rich in salt. They frequently also contain sodium sulphate and magnesium salts. Under dry conditions, salts may accumulate as a white surface efflorescence, but under wet conditions, the soils may exhibit a high water table, and thus resemble salt-marsh soils, whose lack of æration produces characteristic rusty mottling in the lower layers of the soil-profile. Saline soils are usually very permeable to water, owing to the flocculating effect of salts in solution. They are infertile for most crops, but may support a characteristic natural halophyte flora.

(b) **Solonetz** :—When solontshak is subjected to the leaching action of rain or irrigation water containing no salts, profound changes occur, but the final result is largely decided by the presence of calcium corbonate in the soil. Highly acidic lime-free solontshak soils, when leached, merely lose salts; there is little tendency for sodium-ion to replace hydrogen-ion in the original soil hydrogen-clay, so that the leached soil is still acidic. Calcareous soils which possess medium or low lime reserves, on the other hand, contain much lesser amounts of combined hydrogen-ion, their exchangeable bases consists mainly of calcium-ion, which in extreme cases, may almost saturate the clay fraction. Under these circumstances, sodium-ion derived from sodium-salts, may displace calcium-ion, and the resulting soils, after the leaching with pure water has removed salt excess, will consist chiefly of " sodium clay ". Sodium clay is notoriously sticky and cohesive, and the leached soils are difficult to till, compact, impermeable to water, and hard to drain; they " run together " when wetted, and the surface dries into a hard layer or pan. Such soils are generally infertile and agriculturally useless.

(c) **Soloti** :—Further profound leaching of Solonetz soils, especially those containing appreciable lime reserves removes all soluble salts, and eventually brings about the replacement of sodium-ion, combined in sodium-clay by calcium-ion. The physical properties of the soil are thereby greatly improved, for "calcium-clay" is not sticky, but tractable, permeable, free draining, open, friable and crumbly. The reaction becomes less alkaline (pH 8.4 or below) and the soil is usually very fertile for many crops. Solonetz soils containing smaller lime reserves may gradually become acidic under continued leaching by water containing carbon-dioxide—combined calcium-ion being progressively replaced by hydrogen-ion. The displaced calcium-ion may first accumulate as concretionary calcium carbonate in the lower soil-layers. The soil-profile at this stage may resemble that of "black earth" (Tschernosem), characteristic of steppe and prairie country. Later, the lime entirely disappears, and the soil becomes "degraded" into an acidic soil type, in which sesquioxides accumulate in the lower layers. Eventually, the sub-surface soil consists of residual silica, bleached white through loss of iron oxides, highly acidic in reaction, and infertile to crops. Such highly leached soils display a profile which, in extreme cases, resembles that of Podsol, a characteristic soil type of humid climatic regions.

(d) **Rendzinas** :—These fertile, highly calcareous, non, saline soils exhibit a typical black, humic surface layer of varying thickness, merging suddenly through a more or less definite grey or pale-brown transition layer, with the underlying whitish parent rock (limestone, coral or marl). The surface soil is often heavy and plastic; leaching may have removed much calcium carbonate, so that the reaction may be well below pH. 8.4 which represents the degree of alkalinity of a saturated solution of calcium carbonate in carbolic acid.

Continued leaching may change black Rendzina to red "Terra soil, Rossa" as in the uplands of Cuba and Barbados. Typical Terra Rossa occurs in the Mediterranean region; its surface soil is usually acidic.

III. Agricultural Relationships of Saline and Alkaline Soils :—Much recent research has been directed to an elucidation of the reasons why saline and alkaline soils are so infertile and unproductive, and to means of ameliorating this condition by schemes of reclamation. Formerly, the infertility of these soils was attributed solely to the direct

toxic effects on plant-growth of the various salts in solution. It is nowadays realized that moist soil is not simply a mixture of water and inert solid matter, but that the two components interact in a very complicated manner, giving products whose properties and composition depend upon the relative amounts of the interacting components, as well as upon their chemical constitution. A study of the practical significance of this generalisation involves several more or less distinct aspects, which perhaps may best be considered individually.

I. Reaction and Concentration Relations:—When alkaline soils are treated in the laboratory with water, the degree of alkalinity developed depends on the extent of the dilution. Thus an extract prepared by mixing one part of soil with one part of water may show a pH value 8.60 but with 20 parts of water, the pH value may rise to pH 9.42 and with 160 parts of water, to pH 8.98. The difference between the first two values represents a seven-fold increase in alkalinity, due entirely to greater soil dilution and hydrolysis. On the other hand, dilution merely lowers the concentration of salts such as sodium chloride in saline soils, and thus renders them less harmless to plants. Hence the behaviour of saline and alkaline soils depends upon their degree of moistness in the field. Under wet conditions, alkalinity becomes enhanced, but salinity is much decreased whilst under dry conditions, alkalinity is somewhat diminished, but salinity may attain highly injurious concentrations. The height of the water table level in saline and alkaline soils is therefore an important factor in their agricultural relationships. It should be given careful consideration when alkali soils are irrigated, for irrigation may raise the water-table and thus increase the alkalinity of the surface soil, or bring up salts from subsoil.

II. Carbondioxide relations:—In our discussion of the chemistry of saline and alkaline soils, it was noted that the first alkali to appear when saline soils are changed into alkali soils by prolonged leaching, is sodium hydroxide, generated by hydrolysis of "sodium clay." In the presence of excess of carbon dioxide, sodium hydroxide becomes converted into sodium carbonate, and finally into sodium bicarbonate. These salts (particularly the latter) are much less alkaline than sodium hydroxide so that carbon dioxide acts as an alkali corrector. Thus about three times as much sodium carbonate, and great many times as much sodium bicarbonate, than sodium hydroxide are required to give an alkalinity of pH 8.65 to their solutions in water. The fixation of alkali as sodium

carbonates depends on the carbon dioxide concentration of localised soil atmosphere and this in turn, depends partly on the quantity of soil organic matter that is undergoing oxidation through the activity of certain soil bacteria. Addition of bulky organic manures and green dressings to alkaline soils should therefore effect beneficial changes.

III. Effect of Gypsum on Alkaline Soils:—The application of gypsum (calcium sulphate)—another corrective for soil alkali--is also well-established practice. The treatment was first advocated in 1888 by Hilgard, who attributed its effect to interaction with sodium carbonate, whereby calcium carbonate and sodium sulphate are formed, so that soluble alkali is replaced by a soluble neutral salt, and thus rendered innocuous. Gypsum is not always effective, however, in reducing soil alkalinity, and it has been shown that, in the absence of carbon dioxide, gypsum-treated black alkali soil always contains an appreciable undecomposed residue of sodium carbonate. Hence gypsum should be accompanied by organic manures or by sulphur if successful results are to be obtained. Where the soil contains excessive amounts of salts, gypsum has little effect until the salts have first been removed by thorough leaching.

The modern view regarding the action of gypsum on alkaline soils, is that an excess of calcium-ions, derived from this or some other soluble calcium compound, first displaces sodium-ion from sodium-clay, thus rendering the soil more permeable. The liberated sodium-ions and the residual sulphate-ions are then easily leached by watering. Green manuring greatly enhances alkaline-soil improvement by opening up the sub-soil by root penetration. Certain green manure crops, such as lucerne, and Melilotus alba, Panicum crus-galli, Cynodon dactylon (Bahama Grass), and other grasses can tolerate considerable amounts of alkali, and are useful for this purpose.

IV. Permeability of saline and alkaline soils:—The great difference in permeability between sodiumclay and calcium clay has already been mentioned. Since the success of irrigation for reclaiming alkali lands depends mainly on the ability of the soil to "take water" the question of soil permeability in relation to the proportionate amount of exchangeable sodium and calcium present has naturally received considerable attention from alkaline soil investigators. Thus, attempts have been made to establish mathematical expression of this relationship, (Ca/Na ratio) so that farmers might predict therefrom the

behaviour of any soil whose exchangeable base content has been experimentally determined. Unfortunately the results obtained have proved disappointing.

There is another factor, in addition to exchangeable sodium, that greatly affects the permeability of alkali soils; it is the formation, precipitation and accumulation of colloidal hydrous alumina and aluminosilicates within the soil, which lead to its "freezing up" or congelation.

V. Reclamation by irrigation:—There is only one practical way of reducing the salt content of saline and alkaline soils, namely by flooding and draining. Where the salts consist of the sulphate, chloride and nitrate of calcium, little difficulty is experienced in reclamation. Where the salts are mainly sodium salts (chloride and sulphate) irrigation with water rich in soluble calcium compounds is also usually effective, but irrigation with pure water invariably ends in failure, the soil rapidly becoming impermeable and no longer "taking water" readily. An adequate dressing of gypsum applied to these soils may sometime alleviate the trouble, as has already been indicated, but usually the quantity of gypsum required is relatively great. Irrigation with water containing sodium salts even in small amounts, eventually is harmful and should be avoided. Sepage of saline water from higher levels must be prevented during irrigation. The likelihood of injury through irrigation and seepage depends partly on soil texture, a well-drained sandy soil being less susceptible than a badly-drained heavy soil.

VI. Nutrient relations:—(a) *Phosphate*—Alkaline soils, including normal highly calcareous soils (Rendzina), yield large amounts of phosphate to extracting agents, such as various dilute acids usually employed for its assessment in laboratory studies. Nevertheless, crops grown thereon generally show marked response to soluble phosphatic manures (acid super-phosphate; nicifos; ammophos), but rarely show response to insoluble phosphatic manures (rock phosphate, basic slag, bone-meal). The phosphate-supplying ability of a soil (i. e. its capacity for maintaining an adequate rate of delivery of phosphate to plants), varies with soil conditions (including soil reaction), but it is also influenced by plant growth process. Thus solvent root excretions, particularly carbonic acid, increase the availability of soil phosphate in the immediate vicinity of plant roots (by reducing the reaction to about pH 6.2 or 6.4) and rapid root absorption lowers the phosphate

gradient, so that phosphate uptake may reach adequate magnitude, even in somewhat alkaline soils. Any factor (for example, decomposing organic manure) that increases the carbonic acid content of the soil surrounding plant roots may aid in the solubilising process. Nevertheless, plants seem to differ in the "feeding power" of their roots, for some species are apparently able to abstract more phosphate from an alkaline or calcareous soil than others. Quite apart from its effect on the solubility of phosphate, soil reaction appears to exert marked influence on the process of absorption of phosphate by plant roots. Evidence has been adduced from water-culture experiments which demonstrate that little phosphate absorption by plant roots actually takes place at reaction values above pH 7.6, except in those cases where the diffusion of carbon-dioxide is sufficiently rapid adequately to reduce alkalinity in the region of root contact.

(b) *Nitrate and Potash*:—The results obtained for phosphate absorption by plants placed in media of different reaction values, have been closely reproduced for nitrate and potash absorption under similar circumstances. Alkaline reactions apparently greatly depress the absorption of nitrate and potash, as well as phosphate, so that, without the aid of carbon dioxide within the root-zone, plants cannot obtain adequate supplies of these nutrients from highly calcareous soils and alkaline soils. Whether they can absorb and utilize ammonium-ion under these conditions, however, seems not yet to have been determined.

IV. Summary and Conclusions: Causes of Infertility in Saline and Alkaline Soils:—During recent years, there has been a marked tendency to stress more and more the profound deleterious effects of "black alkali" on the physical properties of alkaline soils in the field, and to minimize its direct toxic action. Detailed studies have demonstrated that, with the usual degree of moistness that obtains in field soils, and near the wilting point of plants, soil alkalinity is seldom excessive, even though laboratory examination, under imposed conventional conditions, may indicate high reaction values. When black alkali soils are subjected to thorough leaching by irrigation and drainage, and are afterwards adequately tilled, dressed with gypsum, and treated with organic manures their fertility generally improves and satisfactory crops may be grown on them.

In the case of saline (white alkali) soils, circumstances are somewhat different. Under low moisture field conditions, salts may become concentrated in the soil water until the limit of tolerance is reached,

where plants fail to grow because of the operation of osmotic and dehydrating effects. The toxic limit in most cases of crop-plants appears to lie in the region of 1000 parts of common salt and less than 1000 parts of sodium sulphate per million parts of soil-solution.

The nutritional disorders accompanying alkalinity in alkaline soils, especially calcarious soils, have lately received special consideration. Recent investigations have demonstrated that, under alkaline conditions (pH values greater than about pH 8.0) soil phosphate is immobilised as insoluble compounds involving calcium carbonate and alumina. Highly calcareous soils may also fix iron oxide and manganese oxide, so that plants growing thereon may suffer marked chlorosis, through lack of adequate chlorophyll formation.

The uptake of nutrient-ions (phosphate, nitrate, potash) by plant-roots is greatly reduced when the alkalinity of the soil solution exceeds magnitudes represented by pH 7.6 or pH 7.8. In highly alkaline soils (reaction values above pH 8.5), aluminium may exert direct toxic action through the formation of aluminates.

It is evident, therefore that the main factor responsible for the infertility of alkaline soils is their unfavourable reaction. Soils whose reaction values lie above pH 7.8 or pH 8.0 should be regarded with suspicion, and suitable steps should be taken to reduce their alkalinity. In the case of saline soils, uncomplicated by reaction effects mere removal of salt excesses by leaching should prove effective in their amelioration.

UTILIZATION OF EXCRETA AS MANURE. *

By D. V. Bal,

(Offg. Agricultural Chemist to Govt., C. P.)

It has long been recognized that the available sources of farmyard manure cannot supply the required quantities of organic matter to the soil and that it is therefore necessary to utilize other sources of organic matter to recuperate the soil humus. The importance of excreta as a soil fertilizing substance has long been recognized by the cultivators in India, which is evident from the high prices offered for the *khari* or *gaorasa* land which, being situated near about the village, gets fertilized with human excreta and gives greater outturn of crops than ordinary fields. Although the value of nightsoil is recognized, its use as manure

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has been much neglected, chiefly on account of the distasteful task of applying it to the land and even if odourless material is manufactured by artificial processes, caste prejudice and conservatism will prove formidable obstacles in the way of its utilization.

Taking high averages, an adult excretes during a year about 12 lbs. of nitrogen, 7 of phosphoric acid, and 5 of potash, worth respectively about 7s. 6d., 2s. and 1s., or 10s. 6d. a year in all, when converted into a marketable fertilizer. Though for a large population the total waste may thus seem to be enormous, 10s. 6d. per head is yet but a small amount to be set against the expense of dealing with such a quantity of low grade material so difficult to handle. According to the present prices of various fertilizers, the total cost of the fertilizing constituents voided by an adult comes to Rs. 6/- per annum.

Human excreta must, however, be disposed off in a judicious manner in order to maintain perfectly sanitary conditions for the well-being of the population, as if it is allowed to contaminate water supplies from the tanks, rivers or wells it is extremely dangerous to human health. Any method adopted to dispose off the human excreta must therefore have as its primary object the conversion of the crude substance into a harmless product from the point of human health, and in doing this if the material can also be used as a manure to enrich the land, a dual purpose will be served.

In order to appreciate the importance of certain conditions indispensable to successful treatment of human excreta it is necessary to understand the principles of the process. These are brifly given by Dr. Reid as follows:—

"Sewage when brought in contact with suitable land or properly constructed artificial filters, is immediately attacked by living organisms (bacteria) universally present in the upper strata of the soil and in sewage, and which in time develop in the interstices of filters; by these, its organic matter is split up into simple constituents, which, with the assistance of the oxygen and carbonic acid gas present in the ground air or the air in the filter, unite with certain mineral bases in the soil and in the sewage itself, and thus are transformed from organic, unstable compounds, liable to putrefactive changes, into more fixed inorganic salts of an innocent nature. The chief requirements, therefore, essential to success are land or artificial filtering media which are permeated throughout by microscopic life, and of such a consistency as will allow of the free penetration of air.

We shall now briefly consider the various methods of dealing effectively with human excreta :—

Methods applicable to rural areas.—(a) *Earthcloset system* :—According to this system the excreta are mixed with fine dry soil which deodorizes them quickly and completely by means of bacterial agencies. Poudrette thus prepared can be spread upon the land and used for growing crops. The chief difficulty, however, in the adoption of this system is the prejudice on the part of the cultivators in handling even the deodorized material.

(b) An alternative method advocated by Mr. M. K. Padhye of Nagpur, which does not necessarily involve the handling of the deodorized material, is the use of the movable latrines. The estimated cost of the movable latrine is about Rs. 40/- to Rs. 50/-. In Nagpur these movable latrines are demonstrated by Mr. M. K. Padhye, Advocate, who will also be glad to get these manufactured for those who may require them. The essential requirements of this method are as follows :—

1. A movable latrine on wheels.
2. The movable latrine should be put on iron rails placed lengthwise on a trench. The trench should be 2 feet wide 3 feet deep, and as long as the space permits.
3. There are two boxes on two sides of the latrine in which dry pulverised soil is kept and every person using the latrine is required to cover the foeces etc. with sufficient dry soil which can be taken out of the box by means of a trowel provided for the purpose.
4. After the trench is filled with nightsoil at a particular spot on which the latrine has been fixed, the latrine should be moved a little further and the process repeated till the whole trench is filled up. When one trench has been used up in this way another trench could be used.

Vegetables can be planted on the used up trenches during the rainy season or where possible poudrette can be carted to the fields and the trenches utilized again for the disposal of human dung and urine.

II. Methods applicable to urban areas.—(a) *Pitting system* :—According to this system which is followed in some of the bigger towns, the nightsoil is deposited in pits measuring 10 feet by 6 feet by 4 feet. About 100 cubic feet of sewage are emptied in each pit in 10 to 12 separate layers, about 4 inches of earth being thrown over each layer of night soil.

These deep pits do not however allow the night soil to get itself oxidized and deodorized, until after the material has remained buried for nearly two years and even after this period the poudrette obtained from the pits must be handled by the cultivators in order to utilize it as a manure.

(b) *Meagher system*:—The system as described by Captain Meagher is as follows:—

For the contents of each filth cart, a rectangular space is taken and the top soil spread off to the edges to a depth of 3 inches. The soil at the bottom of the space is then loosened and pulverized to a depth of 6 or 7 inches. The shallow trench having been thus prepared, the contents of the filth carts (Crowley pattern) are tipped into it. If the bottom soil has been well pulverized, the fluid portion soaks into it quickly, leaving a thin stratum of the solids on the top which is now covered over with the 3 inches of earth first removed. The shallow trenches are prepared in succession, leaving a space of about 4 inches between them.

(a) *Modern method of sewage purification*:—According to the modern methods, the sewage from a city having a plentiful supply of water, is carried to a sewage purification station by means of underground pipes. The material after it reaches the required place is either purified by a process of sedimentation and filtration in a series of tanks or is artificially oxidized and deodorized in a series of tanks by blowing air in the liquid by the activated sludge system. After the solid portion of the sewage is oxidized and deodorized, the clear non-putrefactive effluent water is used directly on the fields for purposes of irrigation. The oxidized solid material which settles at the bottom of the tanks as sludge is periodically removed and it can be used directly as manure in the same way as farmyard manure. The sludge is rich in nitrogen and free from any offensive odour.

(d) Night soil can be used as an inoculant in the process of manufacture of organic manure from town rubbish or *Katchra* and for this purpose an emulsion of the material has been found to be very effective. Experiments at the Nasik depot with town refuse, and at Cawnpore with banana stems, have shown that night soil produces quicker fermentation than cowdung. This method has also been recently reported to have worked very satisfactorily and economically at Indore, where widely varying proportions of refuse to nightsoil were employed. The process was found to be free from nuisance and simple enough to be handled efficiently by the sweepers without supervision.

THE WORKING OF THE DEPARTMENT OF AGRICULTURE, C. P. 1931-32 AND 1932-33.

(Resolution of the Local Government on the working of the Agriculture Department, C. P.)

1. The agricultural and financial conditions being more or less the same during the two years under review, it is proposed to review the working of the agriculture department for these two years together rather than for each year separately. The recommendations made by the Financial (Retrenchment) Committee were given effect to by abolishing one Deputy Director's circle, holding in abeyance two posts of the Deputy Director of Agriculture, and abolishing the post of the Agricultural Engineer. The cadre of Extra Assistant Directors of Agriculture has been reduced by four posts and that of Agricultural Assistants on the field staff by 13 posts. Five Agricultural farms and four District Headquarter Gardens which were managed by the department have been leased out. The financial result of these retrenchment has been that the net expenditure of the department is now slightly over six lakhs having thus reached the lowest figure since 1927—28 when it was in the neighbourhood of ten lakhs.

Government, however, notes with satisfaction that this retrenchment has not had any immediate adverse effect on the main activities of the department such as the production and distribution of improved seed or the number of practical demonstrations carried out by the district staff. The total number of private seed farms increased during the period under review by over 2000 and the approximate area sown with improved seed obtained from various sources was approximately 16 lakhs of acres. The increased out turn resulting from the improved seed even with the present prices comes to about 68 lakhs which shows that the money spent by the tax-payers on the department brings a substantial return despite the prevailing low prices.

2. Government notes with pleasure that the Agricultural College has once again settled down to steady work and it is a matter for satisfaction that the Inspectors, one of whom was the Principal of the Agricultural College, Cawnpore, pronounced the general tone of discipline in the College to be excellent at their quinquennial inspection carried out on behalf of the University of Nagpur. In this connection Government notes with regret the departure of Mr. Allan who was the Principal of the College since 1907, except for two periods, to take up

his duties in another province. During his time the college rose from an Agricultural school to its present status of a constituent college of the Nagpur University, and Government desires to acknowledge Mr. Allan's devotion to the welfare of the college and his insistence on a high standard of efficiency. There is a fall in the number of applications for admission to the College, 75 in 1932—33 as against 132 in 1930—31, which is probably due to restricted prospects of employment in Government service. Annual visits to selected farms in the province continue to be a commendable feature of the training imparted in the college.

3. Government has read with interest the progress made by the Powarkheda Agricultural Anglo-Vernacular Middle School, and is glad to learn that it is attracting the sons of malguzars and cultivators. It is likely that the number of applicants seeking admission may be affected by the present wave of depression, although during the period under review the number of boys on the roll has not undergone any change. In these circumstances the school authorities have taken a step in the right direction in reducing the messing charges and thus lowering the cost of training in the institution.

Government has learnt with interest that efforts are being made to impart training in dairy farming and gardening to persons belonging to classes which make their living by these occupations. Government, however, trusts that it will be realized sufficiently that the aim of agriculture training is to impart technical knowledge useful for agricultural and allied professions and not to secure Government service for those who receive such training with the curtailment in expenditure which the department is compelled to effect, the prospects of employments in Government service are bound to diminish appreciably in the near future.

4. Government is again glad to record its indebtedness to the Indian Central Cotton Committee for its continued support of the work of cotton improvement. Substantial grants amounting to a total of Rs. 56,325 were received from the committee to maintain the botanical scheme which deals with the fundamental aspects of the cotton improvements such as length of lint, yield, wilt resistance, etc. The experiments on the different strains of cotton are still progressing and it is hoped that they will result in the discovery of a strain which will satisfy all the commercial and agricultural requirements. Although the cotton season of 1931—32 was distinctly infavourable to cotton and the experience of verum growers was not satisfactory, it is noteworthy that

the area under that variety showed an increase. The demand for *verum* seed has remained unaffected, mainly on account of the organization for the sale of cotton which the department has operated during recent years and the high price for which graded *verum* lint could be sold as compared with local varieties. The assistance rendred by the Indian Central Cotton Committee has made it possible to maintain an additional temporary staff to ensure the purity of the growing crop, to assist in marketing operations and to arrange for seed distribution in the following season. The pooling scheme unfortunately dealt with a far smaller number of cotton bales than was expected in both the years under review. Thus in 1931—32 only 2250 bales were dealt with under the scheme, and in 1932—33, 3971. This shortage is due to various factors among which may be mentioned the low outturns of cotton per acre, the impossibility of keeping the full area under the variety pure and the temptation to sell in the open market when the prices were high. Government notes that certain modifications have been introduced in the scheme as a result of past experience which it is hoped will add to its success in future. Government however hopes that the Co-operative associations which are really the best agencies for dealing with this kind of work will take their share in shouldering the responsibilities associated with these sales.

5. Government is also glad to note that a scheme financed by the Imperial Council of Agricultural Research for the improvement of rice has been inaugurated and desires to acknowledge the assistance which is thus being given to raise the standard of cultivation of this important crop. The scheme is to extend over 5 years and involves a total expenditure of approximately one lakh of rupees. It is satisfactory that a certain amount of useful work has already been done in this direction which can be continued on more intensive lines in future.

6. Propaganda work was carried out on the usual lines in the districts but the prevailing conditions, make the agriculturists somewhat reluctant to undertake additional capital expenditure. As a consequence there was in general a reduced demand for implements in 1931-32 but the sales have appreciably improved during the year 1932-33. Similarly the demand for breeding bulls has fallen on account of the prevailing financial depression and the cattle-breeding farms, though working satisfactorily, must wait for a return of better times before their work can be expanded appreciably. It appears to government

that efforts must be made to find out new avenues in agricultural practice whereby the income of the agriculturists can be increased, and government has noted with interest the growing popularity of garden crops in the Chhattisgarh Division.

7. Government regrets that since the establishment of the department on the present lines about the year 1905, the time has now come when a number of senior officers, among whom is the Director of Agriculture himself, will be retiring and the services of a number of men of long experience will be lost in the near future. It is, however, satisfactory to find that an increasing number of Indian Officers with adequate experience and training is becoming available. Mr. Plymen has been holding charge of the office of the Director of Agriculture, since 1920, and during this time the department has increased its activities in several directions. It has been organized and developed on sound lines and the popularity of the department is in no small measure due to his personal qualities. Government's thanks are due to him for the successful administration of the department not only during the years under review, but throughout the time he has held charge of it.

Gleanings

Cream Jaggery:—The Agricultural Chemist, Madras, has evolved a new process of jaggery manufacture with the aid of paddy husk charcoal. The use of charcoal in the manufacture of white sugar is well known. The process in question is based on that analogy. The bulk of the population in India consume sugar in the form of jaggery and the preparation of this substance is an important cottage industry in India; and yet most of the jaggery that is now produced in this country is unattractive in colour, does not keep well, and hardly pays the labour and expense involved. These and other defects inherent in the variety of cane are corrected by the use of activated charcoal and the result is what the Agricultural Chemist calls "Cream jaggery" of attractive colour, good crystalline structure and better keeping quality The new process places in the hands of the *ryot* an efficient and simple method of cleaning jaggery and rab by a process within the reach of most cultivators particularly in regions where paddy and sugarcane are grown side by side. It will provide the public with a jaggery which is more pleasing

to the eye and to the taste, and a form of sugar which is certainly more nutritious than white crystal sugar.

Output of work and standard of life:—In a recent issue of the *American economic Review* Mr. Thomas T. Read makes an interesting contribution on the quantitative relation between work and wealth which throws some light on the important question why standards of life are poor in certain countries while they are very high in certain other countries. Mr. Read makes an attempt to compute the total amount of work done in the world in terms of daily output *per capita* horse-power-hour. He estimates the total daily output of work in the world at 3747.78 million horse-power-hours. Of this the people of the U.S.A. is responsible for 1643 million horse-power-hours. Next comes Germany with 376.5 million hours. Then follows Britain with 317.3 million horse power hours. The total output of work in India is only 151 million horse-power-hours. The per capita daily output of the various countries are as follows:—

America	...	13.38	horse-power-hours.
Canada	...	13.03	Do.
Norway	...	7.58	Do.
Belgium	...	6.85	Do.
Britain	...	6.65	Do.
Germany	...	6.04	Do.
India	...	0.47	Do.
China	...	0.45	Do.

India has just managed to rank above China. The poor output of work in India and China is due to the fact that in these countries most of the work is done by hand, and manual labour is the least efficient reckoned quantitatively. In America only 40 million horse-power-hours of work are due to human labour and it is even less in the other countries.

Sulphuric acid as a weed killer:—In a recent issue of Nature (July 22, 1933) there is an interesting article on the use of sulphuric acid for the destruction of weeds on a field scale. Pioneer work in this direction was conducted by Rabate in France in 1911. The method has now become very popular and in 1931 about 27,000 tons of this substance was used for weed killing purposes in France, whilst some twenty French manufacturers produce suitable spraying machines for its application. It is also gaining ground in England and this summer several thousand acres have been sprayed with uniform success and the farming fraternity has evidenced a considerable

interest in the novel process. The method of application consists in first mixing the commercial brown oil of vitriol with water to give a 7 to 10 percent solution and then spraying it over the land from a suitable machine either horse or motor drawn. About 100 gallons of the liquid is required per acre and may be increased to 150 gallons according to the condition of the field. The cost of spraying is 12s. 6d. to 15s. per acre depending upon the acreage treated. The actual benefit of spraying is claimed to be as much as £ 2 to £3 per acre in the most favourable cases.

Flood prevention :—Floods and inundation often inflict severe losses on the agriculturists all over the world. The Hwang-ho or the great yellow river of China is one of the worst sinners in this respect constantly inflicting untold losses on those dwelling on its extensive banks. At the request of the Chinese Government. The Research Institute for Waterways and Water Power, Bavaria has undertaken to study the ways and means of preventing the great floods and changes of course with which the troublesome river so frequently afflicts china. At the foot of the Bavarian Alps near Walchensee the institute has built a model stretch of the river strictly according to scale and has started studying the working of the river creating the same conditions as in the river itself. Special attention was given to the volume of mud carried by the water and the amount deposited by it along its bed, both of these being the main factors responsible for the periodical inundations and destructive changes of river bed. After each spell of "High Water" the river bed was carefully studied to determine how much mud had been deposited there or along the banks and at what points the water had carried away mud previously deposited. The chief end in view is to determine to what extent the Hwang-ho can be compelled to deepen itself by narrowing it and raising its banks. It is expected that the lesson learned by the engineers in these studies will be applied by the Chinese Government to the Hwang-ho so that floods of that mighty river will be minimized.

A plant for making plant food :—In this new mixer the three principal plant foods, nitrogen, phosphoric acid, and potash are combined to produce a "complete" fertilizer. This particular plant, however, is using the newest improvement in fertilizer manufacture—adding the necessary nitrogen in the form of ammonia-urea solution, a recent development by duPont. As soon as the solution is introduced into the mixer, the free or inorganic ammonia reacts with the superphosphate to form amonium phosphate, ammonium sulphate, dicalcium phosphate and when large quantities of ammonia are introduced, some tricalcium phosphate. The urea in the solution is percipitated in the fertilizer in such a finely divided state and is so intimately mixed

with the other constituents that its presence cannot be detected microscopically, but can readily be shown by chemical analysis. Experiments have shown that this method of introducing urea and ammonia separately, giving more intimate mixing, prevents segregation and reduces the tendency of the fertilizer, to absorb moisture from the air. Urea is generally recognized as an excellent source of nitrogen for all crops. Results have shown that urea is superior to other organic sources of ammonia and is an exceptionally good source of nitrogen for tobacco, potatoes, and many truck crops. Urea is not readily leached from the soil by heavy rains; in this respect it is superior to nitrate sources of nitrogen. (*Scientific American*).

Farm carts with pneumatic tyres:—In an interesting article in the July number of the Allahabad Farmer Mr. H. K. Mukerji says that the Engineering section of the Allahabad Agricultural Institute has succeeded in constructing a farm cart with pneumatic tyres suitable for use under Indian conditions. It is an all steel structure with a suitable removable wooden frame work for carrying loads like *bhusa*, fodder wheat, barley gram and *arhar*. To put the cart under a severe test the trial run was made with a load of 900 bricks each brick weighing $7\frac{1}{2}$ lbs. which is a total of 6750 lbs. on a rutted Macadam road. The speed at which it went on level roads pulled by a pair of good sized bullocks was $2\frac{1}{4}$ miles per hour and up a gradient of 1 in 25 ft. at 1.1/3 miles per hour. Besides advantages like smooth running on all surfaces leaving no aftermath of ruts and ridges, damage to grass land and danger of damaging the roots of crops over which the wheels may pass, it needs only two bullocks to haul a load more than a country cart can hold with three bullocks. The cost of the cart is put down at Rs 350 complete.

Smudging of mangoes:—Smudging can be defined as the production of a suffocating smoke by means of a slow burning bonfire. The smudges were built at an average distance of 8 meters to windward of each tree, three smudges to every four trees, 95 trees being treated. Flower buds emerged in 84 percent of the cases in from seven to nine days, pollination taking place while the flowers were fragrant, two weeks after first emergence of the bud. The fruits matured in less than five months from emergence of the bud. Trees not producing flowers within 14 days of continuous smudging will not as a rule do so at all that season, particularly if the twigs and leaves are less than a year old. Smudging was discontinued when the flower buds had emerged and had grown to 5 cm. Since trees as far as 60 m. away were forced into bloom by smudging, and since in certain districts where the wind is unsuitable smudges are built on platforms actually in the branches of tall mango trees, it is considered that the premature

flowering is not induced by the increased heat of the ground. The best yields were obtained from trees smudged in December and January. November smudging was not successful owing, it is thought, to the prevalence of pests and disease. *(Phillipine Journal of Agriculture Vol. III 1932).*

Irrigation under Lloyd Barrage Canals :—Final figures are now available to show the results of the working of the Lloyd Barrage Canals in the *rabi* season of 1932-33 which was the first *rabi* season with controlled supplies of water available in the perennial canals in Sind. The total area irrigated during the *rabi* season was 11,55,067 acres, of which the area under wheat was 7,00,230 acres. The total acreage is nearly 30 percent in excess of that forecasted for the initial *rabi* season and this excellent result seems to promise the rapid expansion of *rabi* cultivation in the new conditions in Sind. It is pertinent to note that in the tract under command of the Lloyd Barrage Canals the average area under wheat during the five years ending 1930-31 was 1,83,043 acres only. The area irrigated in the *kharif* season 1932 was 13,45,000 acres, so that in the first full year of operation of the Lloyd Barrage Canals, a total area of 2,500,067 acres has been cultivated under irrigation. This represents more than 37 percent of the whole cultivable area commanded by the canals, or 48.5 percent of the ultimate area of annual cultivation under the canals at final development as forecasted in the project (*The Mysore Economic Journal August 1933*).

A Mechanical Cow that breathes, "Gives milk" and moves her head, eyes, ears and jaws in lifelike fashion :—The most expensive cow in the world, a joint product of nature, art and invention, was "built" to demonstrate a milking machine at the "Century of Progress" Exposition. First a pedigreed Holstein cow was secured as a model for the sculptor. After the cow had been modeled in clay, a plaster mold was made which served as a basis for a life-size papier mache model which was built up in layers so that the shell, made in six sections was three quarters of an inch thick. The pieces of the shell were dried for about four days and then assembled. Iron pipes in the legs of the model were inserted to support the motor platform which carries the "works". The model was then removed to the machine shop where various "surgical operations" were performed to permit movement of the head, jaws, eyes, ears, belly and tail. The mechanism was so cleverly designed by the constructors, Messmore and Damon, that only two motors were required, the plurality of motions being secured by an ingenious series of cams. The head sways, the eyes blink, the ears move lazily and the jaws go through the process of cud chewing, all

with little or no suggestion of mechanical means. Even the movement of breathing by expansion and contraction of the belly and flanks. The tail swings from side to side and at intervals gives a vicious switch. While the mechanism was being assembled, the cow herself was slaughtered and the hide carefully removed so that no seams would be visible when the model was covered. After the hide was dressed so that it would remain soft and pliable, it was applied to the model on which had been placed properly shaped sections of sponge rubber to build up "muscles" and to permit the moving parts to function in a natural manner. Where it was necessary further to conceal the Joints of the hide, individual hairs were cemented to the seams with a solution of latex. One one side of the cow a "trap door" had to be provided so that the attendant can oil the machinery. A cut was made along the irregular edge of a large black spot on the hide so that the edge of the "trap door" is effectively concealed when the flap is down. Simulated milk is pumped from the base on which the model stands, through a pipe to the under and thence through the teats and milking machine. Glass tubing in the delivery hose allows spectators to watch the flow of the "milk" through the machine. (*Scientific American June 1933*).

Feeding a famous jersey cow:—There is a well founded saying to the effect that it is not possible to get from a cow more than you are prepared to put into her in the form of feed. Thus, whenever a new record is established the dairy farmer immediately becomes interested in how the record producer was fed. Many have asked that question since 1st February, on which date the thirteen year-old Jersey cow "Wagga Gladys", completed her 273 days' lactation period with a world's record butter-fat production for her breed of 935.23 lb. (from 17,202 lb. milk) states the New South Wales Agricultural Gazette. "Wagga Gladys" is a member of the Hawkesbury Agricultural College Jersey herd, and this is the second occasion on which she has established a world's record. Chief interest now centres in whether she can better the 365 days, record of 1220 lb. butter fat held by the New Zealand Jersey Cow "Woodlands Felicie". Although varying slightly from month to month during the lactation period, throughout the greater part of the time she was fed on the following ration:—Silage 20 lb. lucerne chaff 10 lb. and 3 lb. of a mixture of bran 100 lb., linseed meal 50 lb., and bonemeal 3 lb. In addition, for every gallon of milk produced, her daily ration was augmented by 2 lb. of a mixture comprising bran 100 lb. maize meal 80 lb. crushed oats 30 lb. and linseed 20 lb. The grazing varied considerably. During the winter months there was a fair picking of green barley and green wheat, and at other times she was given an occasional

day's grazing on short lucerne. No very special treatment was meted out to "Wagga Gladys." She remained with the college herd except during the days when they had to travel more than half a mile to the grazing paddock. She was milked twice a day throughout the test. (*Queensland Agri. Journal July 1933*).

Current Research

Effect of contact of chemical fertilizers with seeds on their germination:— V. G. Gokhale and P. M. Gaywala (*Agriculture and Live Stock in India*, Vol. 3. 1933 pp. 256-263). With the belief that fertilizers have a greater effect on the crop and also to economise on the cost of application, sowing of fertilizers along with the seed is often suggested. In this connection it is desirable to know whether the close contract of a fertilizer with the seed will not have any injurious effect on the germination of the seeds so mixed with the fertilizer. The investigation reported in this paper was started to answer the above question. The effect on germination is most injurious when the mixture of cotton, *jowar* or *bajri* seeds and sulphate of ammonia at the rate of 100 lbs per acre is dibbled in pinches, thus bringing about direct and concentrated contact. Cotton seeds have been found to suffer comparatively more than *bajri* and *jowar*. Drilling of the obove mixture seems to lessen this contact and concentration and thus to effect a marked improvement in germination over the first due to intervention of soil between the seed and the fertilizer. The injury to germination is practically nil when the contact and the concentration of the fertilizer with the seed are still further lessened as by drilling the fertilizer three to four feet behind the droping of the seed in the same furrow or by applying the fertilizer separately either before or after sowing. The contact of the above quantity of the fertilizer with the seed up to two days in the dry conditions of both did not effect any appreciable difference in germination. The failure of germination occurred only when the fertilizer coming in concentrated direct contact under the soil conditions favourable for germination, *i.e.* moist soil, etc. The mere contact of the dry fertilizer with the dry seed for varied periods previous to sowing up to two days does not appear to injure the germination of the seed to any noticeable extent.

Nitrogen recuperation in the soils of the Bombay presidency:—Part 3. D. L. Sahasrabuddhe and N. V. Kanitkar (*Ind. Jour. of Agri. Sci.* Vol. 2, p. 455). The first part of this subject was published as a Memoir in

1925 and the second part as an article in the Indian Journal of Agricultural Science, Vol. 1, part VI, December 1931. These two deal with the nitrogen recuperation of soils under controlled laboratory conditions while part 3 deals with the nitrogen recuperation under field conditions where there is repeated wetting and drying of soils by rain and heat. These experiments were done on soils of the Dry Farm Station opened in 1924, on what may be called a virgin land previously occupied by scrub jungle and *babul (Acacia arabica)* shrubs-a series of determinations of nitrogen contens in various forms from soils receiving different treatments of cultivation and manuring, throughout one complete year, taking the soil samples once every month. The results show that the nitrogen content of the soil is not a constant quantity. It is liable to fluctuate from season to season. Definite recuperation of nitrogen takes place under field conditions of the dry tracts of the Bombay Deccan. Wetting of the soil by the monsoon rains and the subsequent partial drying and heating during the dry spells of the monsoon is favourable for the recuperation process. Better cultivation of the land help to maintain the nitrogen content of the soil fairly high and does not allow a sudden drop after the maximum is reached. Addition of organic matter in the form of farmyard or green manure increases the recuperation power of the soil. The maximum rise of the total nitrogen takes place when the soil moisture is sufficient and the temperature is at or more than 30°C. The highest nitrogen contents are found sometime after the rains cease and then they slowly go down to the lowest point just before rains. The experiments conclusively show that the nitrogen content of the soil is not a stable or a constant quality. There is a certain range for each soil and the actual percent of nitrogen in any soil will depend on such factors as the moisture, temperature and aeration and thus on the climatic conditions of the season *(Author's abstract).*

The influence of green manure and organic residues on nitrogen fixation in soil:—S. V. Desai *(Ind. Jour. Agri. Sci. 3, 299)*. Fixation of nitrogen was observed to occur when green plants of *bajra*, maize, cowpeas and *dhaincha* were added to the soil under favourable condition of moisture, temperature and aeration. Addition of farmyard manure extract increased the rate of nitrogen fixation. Leaves of the perennial plants like *ashoka* were also found to help nitrogen fixation in soil. It has been found that non-leguminous plants like maize and *bajra* brought about more nitrogen fixation in the soil than leguminous plants if used as green manure. The fermentation of the green manures, brought about a marked increase in the rate of nitrogen fixation; but the amount of nitrogen fixed rarely equalled that fixed

by unfermented green manures. Almost all forms of organic material used as manures helped the nitrogen fixing organisms. Fermented straw was found to benifit the soil to a great extent and increased the yield as seen by repeated pot experiments. Various experiments conducted in artificial media have indicated that azotobacter, *B. radicicola*, clostridia, and nitrogen fixing organism from farmyard manure were responsible for addition of atmospheric nitrogen. These experiments also showed that pentosans supplied these organisms with energy for this metabolism. No loss in nitrogen during storage or decomposition of the nitrogenous materials occurred if conditions maintained were absolutely aerobic throughout the experimental period. Materials like cow and horse dung which are known to lose nitrogen on keeping were found to fix atmospheric nitrogen provided ammonia was recovered and taken into account. Experiments have shown that thorough cultivation of soil brought about aeration and there by addition of atmospheric nitrogen (*Author's abstract*).

Nutrition in relation to reproduction with special reference to sterility.— I. Leitch. *(Nutrition Abstracts and Review, Vol. 2, No. 8, Jan. 1933)*. This brief review of the literature shows that under-nutrition or malnutrition due to imbalance of the constituents of a diet, vitamins, proteins or minerals, may seriously interfere with normal reproduction. The influence of such faulty diets has been clearly demonstrated in experimental work with laboratory animals. It is known that similar defective diets occur, with similar results, under extensive conditions of animal husbandry, and they may be reproduced under intensive conditions on artificials rations. No data exist to indicate to what extent such factors do actually affect fertility in practical, intensive or semi-intensive, farming, but they may be of considerable economic importance. In addition to this direct influence of diet on fertility, there is the other, possibly even more interesting and important, indirect effect through its modifying action on susceptibility to infections. It is known that malnutrition practically determines susceptibility to certain infections, and there is evidence that it may be an important predisposing factor in infection with Br. abortus and other organisms which interfere with reproduction. It is perhaps unlikely that an organism of the apparently high virulence of Br. abortus should become innocuous under the most perfect dietary conditions, but the relative importance, as regards subsequent sterility, of malnutrition of the host and virulence of this or other infecting organism, has not yet been established. There is obviously urgent need for further extensive investigations on the whole subject of nutrition in relation to reproduction and the various infections which interfere with conception and the normal development of the foetus. (*Author's conclusions*).

The quality factor in feeding stuffs.—J. A. Murray. (*Journal of Agricultural Science Vol. 23, 1933 p. 185*). In this paper the author attempts to define the significance of quality in feeding stuffs and to show its bearing on problems of animal nutrition. The nutritive value of a feeding stuff may be attributed to two factors, its quantity indicated by the gross energy, and quality as represented by the coefficient of availability (D/T-O. 35) where T represents total and D represents digestible organic matter. The author applies his formula to the results obtained from several feeding experiments and arrives at the conclusion that the nutritive value of the total organic matter depends almost entirely on its digestibility and except in the case of cake, only to a negligible extent upon its chemical composition. Nutritive value is not proportional to digestibility but a linear function thereof. In substance of low digestibility alterations in nutritive value are caused by slight changes in digestibility.

Genetic Association between flowering duration and plant height and their relationship to other characters in rice.—(*Oryza Sativa* L). K. Ramayah (*Indian Journal of Agricultural Science Vol. 3, 1933, pp. 433-445).* There has been established a very definite and strong association of the two characters, height and flowering duration. The correlation between these two characters is generally positive but in some cases it is also negative. Although very definite proof is still not available on the point, it is considered from the behaviour of the parents in the several crosses dealt with in the paper, that the correlation is positive in early varieties and negative in late varieties. Such a behaviour seems to be consistent with a physiological explanation. It is reasonable to expect a physiological correlation between size and duration of growth. Obviously, an extremely early plant cannot in the few weeks of its growth attain a height equal to that ultimately reached by another plant whose period of growth extends over a much longer period. It is quite likely that genetic correlations occur between factors for distinct quantitative characters. These and the physiological correlations make the results more difficult of interpretation but do not throw them out of the realm of Mendelien-phenomena. It is suspected that the correlation between the two characters is necessarily genetic on account of the absence of correlation and segregation for the characters in the progenies of certain crosses whose parents did differ greatly from each other for the characters. These two characters are also found to be associated with other quantitative characters like the length of the ear, and the emergence of the ear. They are also very definitely associated with the final yield, the later and taller plants giving a very much increased yield over the earlier and shorter plants. The larger the difference in the characters between the plants, the greater is the yield difference likely to be. The two characters, height and duration, are also

associated with such qualitative characters as the colour of the glume and the colour of rice. An association has also been noted between flowering duration and the lodging or erect nature of the straw (*Author's summary*).

Crop Forecasts

WHEAT

All India Final General Memorandum on the wheat crop of 1932--33:— This memorandum is based on returns of finally revised acreage and outturn of the wheat crop of the season 1932—33 received from local authorities, and refers to a little over 98 percent of the total wheat acreage of India. Lhe returns, therefore, cover practically all the important wheat growing tract in India.

The total area reported is 32,992,000 acres, as against 33,803,000 acres last year, or a decrease of 2 percent. The total yield of the crop, which has already been harvested, is estimated at 9,452,000 tons (44,109,000 quarters of 480 lbs each), as compared with 9,024,000 tons (42,112,000 quarters) last year, or an increase of 5 percent.

It will be seen that the present estimates of yield as compared with the final figures of last year show an increase in all the important wheat-growing areas except in the Central Provinces and Berar, North West Frontier Province and Rajputana. The yield per acre in the present season is 642 lbs as compared with 598 lbs last season.

In addition to the areas for which particulars are given abave, the crop is grown in certain other tracts from which no reports are received, and the average area under wheat in those tracts for the last five years has been estimated at about 583,000 acres, with a yield of 161,000 tons.

Wheat in foreign countries:—The yield of the 1933 wheat crop in the United States of America was estimated in July last at 496 million bushes (or 13.3 million tons), as compared with 727 million bushels (or 19.5 million tons) in 1932. The area under wheat in Canada in 1933 is reported to be 25.7 million acres, and the condition of the crop was estimated in July last at 77 percent of the normal. The yield of the Australian wheat crop of 1932—33 is estimated at 210 million bushels (or 5.6 million tons), showing an increase of 11 percent as compared with the preceding year. The area for the season 1933—34 is expected to be about 15.3 million acres, or a decrease of 2

percent as compared with 1932—33. The area and yield of the Argentine wheat crop for 1932—33 are estimated at 17,789,000 acres and 6,305,000 tons, showing an increase of 11 and 7 percent respectively as compared with the preceding year.

COTTON

Central Provinces and Berar 1933—34—First forecast:—On an average of the five years ending 1931—32 the area under cotton in the Central Provinces and Berar represents about 19.4 percent of the total area under the crops in British India. The estimated area sown during the year under report is 1,345,948 acres in the Central Provinces and 2,874,602 acres in Berar as against 1,482,463 acres and 3011285 acres respectively at the corresponding forecast of last year. The estimated area under cotton this year shows an increase of 15 percent in Central Provinces and 2 per cent in Berar over the actuals of 1932—33. The slight increase in the estimated area over the actuals of last year is attributed to favourable conditions at sowing time.

United States' cotton crop :—The area under cotton in the United States of America during the current year is now placed at 29,704,000 acres. The yield is estimated at 12,314,000 bales of 500 lbs each (or 15,392,000 bales of 400 lbs each), as against 11,306,000 bales of 500 lbs each reported at the corresponding period last year.

College and Hostel News

After a brief holiday of about ten weeks the College reopened on the 12th of June. The new session was inaugurated by the Principal Mr. J. H. Ritchie with an intersting and inspiring address which is printed elsewhere. Not only the students of the Agricultural College but the student community as a whole, nay, every ambitious young man will find amble food for thought in that condensed but pregnant address. We would commend to the student freternity the following lines which reveal the student psychology and sum up the whole range of "student problems."

"The beginning of a new term or year is usually a time when nearly everyone makes resolutions and determinations to do certain things or to avoid doing others. I have no doubt that each of you has made up his mind to maintain the good place you obtained in your class last year if you did have a good place, or if you did not, to better the place you did get.

I am sure you have all returned imbued with the one desire to do well in the coming year by working hard and concentrating on your work and by eschewing those things which you know frittered away you time last year and made you take a more lowly place in your class than you feel and know you should have. The making of resolutions is easy but carrying them out is a different matter. A cynic once said that the road to Hell is paved with good resolutions which of course, means that the good resolutions are seldom carried into effect. I hope none of you will help to make the road to Hell any easier by adding to the already large accumulation of broken resolutions. Make up your minds to carry your good resolutions into practice and help to pave the way to the formation of a strong character, for character is what education is meant to develop and if you do that, not only will you add lustre to your own name, but you will add glory to your parents, your school, your college, your province and your country."

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The new agricultural season started under almost ideal conditions. The unusual and rather heavy rainfall of May enabled the cultivators to work their land to good condition for early sowing. With the first showers of June cotton and fodder were sown and all the kharif crops got a good start. Every thing looked bright and promising till about the middle of July. The heavy and unceasing rainfall which followed without any abatement for nearly a month brought the soil to a state of supersaturation with the result that timely weeding and interculture became impossible. The crops grew stunted and pale and lost all the advantages of a good start. Floods are reported from several places and much damage to houses and property are reported from Kamptee, in our own neighbourhood. The relieving feature of the situation is that conditions are not as bad every where.

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The batch of B. Ag.s that went out of the college last year has been the biggest in the history of this college. It is unfortunate that this prolificity should happen during a period of accute depression and unemployment. Many of those who have been looking forward to employment under Government as the culmination of their education have been disappointed. Only a handful of them--the pick of the lot--were offered jobs in the Department. We offer our hearty congratulations to Messrs H. P. Dwivedi, E. D. Pimplikar, S. L. Vishnoi and N. P. Deshmukh. Messrs. H. P. Dwivedi and E. D. Pimplikar are appointed as assistants in the Botanical Section of the Research Institute. Mr. S. L. Vishnoi is appointed as an assistant under the Rice Research Scheme and Mr. N. P. Deshmukh on the College Farm. Mr. S. B. Vaidya was appointed as an assistant on the College farm, but he resigned

that post to take up a scholarship for Postgraduate studies at Pusa. While we have no intention to give a sermon, we would remind these friends of the great opportunities they have before them to help the cause of science and of their country. It is upto them to make or mar their future. We hope they will bring credit and honour to themselves and to their *alma mator.*

One of this batch of graduates, Mr. N. K. Ghosh, has however broken new ground. He has joined the M. A. Class to take a Master's degree in Economics. Mr. Ghosh is the first agricultural graduate to take advantage of this new privilege and a great responsibility hangs on him to show to the world that we fully deserve it. Our case for Law and for M. Sc. in Chemistry and Physics will be considerably strengthened if Mr. Ghosh acquits himself creditably in the coming M. A. Examination. We wish him all success.

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On account of the heavy and continuous rain our sporting activities have been rather dull. We have several promising all round sportsmen amongst the freshers, and we are hoping to have a busy season as soon as the rains close. Our play ground is being thoroughly improved and some new games such as Basketball and Badminton have been introduced. We played a friendly cricket match with the C. P. Club though not with much of a success.

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The new secretaries of our College debating society are very enthusiastic and we have already had some very interesting debates. We would suggest that those wishing to take part in the debate should prepare their subject very thoroughly and should aim at making their speeches real contributions to our knowledge on the subject. There is a growing tendency on the part of the debators to play to the gallery and to be frivolous and humorous at the sacrifice of relevancy and matter. This tendency is much to be deprecated.

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We should not miss this apportunity to express our sincere thanks to our new Principal Mr. J. H. Ritchie, M.A., B.Sc., for the very keen interest he has manifested in all the activities of the College. His constant visits to the hostel and the play ground is a source of great encouragement to the students. His sympathy and unassuming manners have won the hearts of the students.

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Janmashtami festival was celebrated in the usual manner with the full

cooperation of all the students irrespective of caste or creed. The management thanks the members of the ... nd students for their help in making the function a success.

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We extend a hearty welcome to the Freshers. From what little we have seen of them we can say that they are a very promising lot and will bring honour and credit to the institution which they have joined.

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We congratulate Mr. P. D. Nair, M.A., L.Ag. (Hons.) on his appointment, in addition to his duties as lecturer in Economics, as Provincial Officer in charge of the Economic Enquiry into the cost of production of crops in the Cotton tract of C. P. & Berar. This is indeed an unique opportunity to study at first hand the rural and agricultural economics of the province. We wish him all success in his new office.

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We offer our most hearty congratulations to Rao Saheb G. K. Kelkar, B. Ag. who has recently been appointed as Offg. Deputy Director of Agriculture, Eastern Circle, Raipur. Rao Saheb Kelkar is a very able officer and has filled with distinction every position he held. We wish him all success in his new office.

The College Debating Society

At the first meeting of the Society the following office bearers were elected for the current session.

President	...	Mr. J. H. Ritchie, M.A., B.Sc.
Vice-President	...	Mr. A. M. Chaudhary.
Secretary	...	Mr. M. S. Nair.
Joint Secretary	...	Mr. T. J. John.

Members of the Managing Committee—Messrs H. Mishra, D. N. Gour and T. P. S. Chaudhary.

The inaugural debate for this session was held on the 26th July 1933 with Mr. A. M. Chaudhary in the chair when the following resolution was discussed.

"This house is of opinion that he who makes two ears of corn or two blades of grass grow where only one grew before does more service to his country than the whole mass of politicians put together".

Mr. K. R. Sontakey, M.Sc., in moving the resolution said that the welfare and prosperity of a nation inspite of all its statesmen and politicians depend entirely upon Agriculture, which with the application of science has developed to a great extent. Mr. T. L. Sheorey, B.A., L.LB. in leading the opposition compared the contribution to Society made by an agriculturist and a politician with reference to the various nationalities of the world. A politician is in his estimation, endowed with powers of construction and destruction.

The other speakers were Messrs. N. M. Deshmukh, R. F. Rustomji, K. M. Kowsik, S. P. Kotval, S. K. Misra and S. K. Dharmadhikari.

We take this opportunity to express our sincere thanks to all the speakers for having responded to our invitations at considerable personal inconvenience.

The Poor Students' Helping Fund Society

Report for 1932—33.

In the first meeting of the Poor Students Helping Fund Society the following office bearers were elected.

Mr. R. N. Kayastha	...	President
Mr. B. S. Rao	...	Treasurer
Mr. D. N. Gour	...	Secretary
Mr. N. W. Tilloo	...	Joint Secretary
Mr. N. B. Chincholkar	representative	4th year
Mr. P. Tiwari	do	3rd year
Mr. H. B. Mishra	do	2nd year
Mr. S. S. Deshmukh	do	1st year

Five meeting were held during the session 1932—33 and the following table shows the help given by the society to the deserving students.

No.	*Aid given to*	*Purpose*	*Amount*		
1.	Mr. P. Tiwari	Running Expenses	22	0	0
2.	Mr. M. D. Anadeo	Stationery	5	0	0
3.	Mr. G. L. Chandore	For working in the store	6	0	0
4.	Mr. D. N. Gour	do	24	0	0
5.	Mr. G. W. Pitale	Inter. Fxam. fees	15	0	0
6.	Mr. H. P. Dwivedi	B. Ag. Examination fees	30	0	0
7.	Mr. B. M. Chandel	do	30	0	0
		Total ...	132	0	0

Total receipts and expenditure of the society are as follows.

Total receipts.				*Total expenditure.*			
Brought foward from last year.	74	4	0	Help to students	132	0	0
				Miscellaneous.	0	6	0
Subscription from staff. and students.	94	1	0	Balance at hand.	34	1	5
Total ...	168	5	0		168	5	0

There were many applications from students for help but all of them could not be met owing to the shortage of funds. The students did not subscribe regularly towards the fund although several attempts were made to collect the arears. The members of the staff subscribed regularly.

One important feature of the society during this session is that a Students' Benefit Store has been opened from the 10th October 1932. The capital was raised by the sale of shares, each share being of the value of Rs. 1. On the 10th October, with the scanty capital of Rs. 58 only, the store was inaugurated by Mr. B. R. Phatak. Afterwards 20 more shares were sold. The students and the members of the staff showed keen interest in running the store and they tried their best to purchase all their needs from it. Due to insufficient investment the store could not supply all the articles the students demanded. During the period of five and half months, the capital was turned over three times. At the end of the year it was found that the total value of the transaction was Rs. 239/3/9. After deducting the running expenditure the profit amounted to 22 percent of the capital invested. According to the store regulations the profits were distributed as follow :—

	P. C.	Amount.
Dividend to share holders	50%	8/7/9
Store Reserve	25%	4/4/-
Poor Fund	25%	4/4/-
Total	100%	16/15/9.

This year the Principal has granted permission to keep all the note books and stationery required by the students of the college and has also directed the students to purchase the same from the store.

The Secretary thanks the President, the Treasurer and the co-workers who helped him in discharging his duties, and also the students and the members of the staff for their interest in the society.

D. N. Gour
Secretary,

The Nagpur Agricultural College Magazine

VOL. VIII NO. 2

NOVEMBER 1933

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PUBLISHED BY P. D. NAIR, M.A., L.AG. (HONS.)
COLLEGE OF AGRICULTURE NAGPUR

Contents.

F. J. PLYMEN, Esq., C.I.E.

Mr. F. J. PLYMEN, C. I. E.,

An appreciation.

The departure of Mr. Plymen from Nagpur on leave prior to retirement makes one realize the extreme youth of the Agricultural Department of this country, for he came out to India on the constitution of the Indian Agricultural Service in 1905 by Lord Curzon. Mr. Plymen followed close on the heels of Dr. Clouston, who was the first member of the Indian Agricultural Service in these Provinces and he joined duty in April 1906 as Agricultural Chemist. Except for a short period during the War, Mr. Plymen spent the whole of his service in the Province nearly half being as Director of Agriculture, which constitutes a record not likely to be broken. He saw the gradual growth of the Department to its present strength and it was a matter of deep regret to him that financial stringency and general depression prevented the further development of the Department with which he had been so intimately concerned for 28 years and on which his heart was set. He leaves behind him a legacy of which any administrator might be proud-a Department recognised to be one of the best and most progressive in the country. The Government showed their appreciation of his work by conferring on him the C. I. E. in 1929, but with characteristic modesty he took that to be an appreciation of the work of the Department and not of himself.

The sympathy and consideration with which he administered the Department endeared him to all his subordinates and the same traits made him innumerable friends amongst officials and non-officials alike. Each member of the staff feels he has lost a personal friend and every one will miss his cheery smile and good humoured witticisms. Mr. Plymen is the kind who makes friends wherever he goes and in his retirement he will not be lonely which is often one of the penalties of exile.

The staff of the Agricultural Department unites in wishing him a long and happy period of retirement which is certain to be spent in the cultivation of his beloved roses.

Mr. J. H. RITCHIE, M.A., B. Sc.,

Director of Agriculture.

On another page we have said farewell to Mr. Ritchie in his capacity as principal. Here we welcome him to his new appointment as Director of Agriculture. Mr. Ritchie joined the Department just over twenty years ago. Since then he has seen service not only with the local Government, but also with the Government of India in both the Military and Civil Departments. He brings to his new post an unique knowledge of the wheat growing tract of the province, based on a long period of service as Deputy Director in the north. He brings, also, perhaps an even more profound knowledge, commercial as well as cultural, of the most important money crop of these provinces, namely cotton, acquired during his tenure, successively of the posts of Deputy Secretary and Secratary of the Indian Central Cotton Commitee. In the latter appointment he proved a worthy successor to his able predecessor, Mr. Burt. It was during his tenure as Secretary that the Cotton Transport Act was applied to Hyderabad, Indore, the Central Provinces and Berar and Broach ; and that an important change of policy was initiated whereby the Indian Central Cotton Committee agreed to give financial assistance in the wider distribution of the seed of improved varieties of cotton to the growers. The result of this change of policy has been the inauguration of more than a dozen seed-distribution schemes, an outstanding example of which is our provincial *verum* pooling organisation which is now so popular with *verum* growers. Mr. Ritchie also had the satisfaction of seeing the number of research schemes financed by the Committee increased from 13 to 25, and the introduction of a publicity system the object of which is to help local authorities to disseminate, as widely as possible, the results of those Schemes.

We wish Mr. Ritchie all success in tackling the arduous and responsible duties which lie before him, and we feel confident that, under the stimulus of his leadership, the Department of Agriculture will be inspired to still greater efforts to promote the welfare of the farming community.

J. H. RITCHIE, Esq., M.A., B. Sc.

The Nagpur Agricultural College Magazine

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Editorial

THE GHI PROBLEM IN INDIA

Ghi or butter fat has a great physiological and nutritive value and constitutes an important item in the diet of Indians. The chief value of *ghi* is in its vitamin contents, particularly of vitamin A. This vitamin is responsible for growth in animals and for conferring the power of disease resistance. To the people of India particularly to the vegetarian section, *ghi* is the chief source of this vitamin and if an adequate supply of it is not maintained in their diet it is bound to affect their health. In former times *ghi* was available in large quantities and at cheap rates, with the result that almost every one had enough of it. But at the present time it is so costly that only the rich and the upper middle class people can afford to buy adequate quantities of it. The vast majority have to go without it or have to be satisfied with some cheap substitutes.

Adulteration of *ghi* has become such a common practice that it is almost impossible to secure pure samples of it in the market. Several substances such as vegetable and mineral oils, tallow, etc, are used for adulteration purposes. The substance that its most commonly used is what is known in the market as vegetable *ghi*. This is only the edible vegetable oils subjected to certain procesess whereby they are decolourised and solidified to

appear like *ghi*. Hence it is only as good as the ordinary oils and to palm it off in the name of *ghi* constitutes cheating with regard to one of the essential articles of food. It is absolutely necessary to put a stop to this practice in the interests of the health of the people. It is very gratifying to note that the Bombay Corporation has started a crusade against dealers in adulterated *ghi* and butter. Several prosecutions were launched and the newspaper reports of the proceedings in Court give an indication of the filthy nature of the article that is sold under the caption of *ghi* and butter in the markets. Most municipalities and corporations have powers to prevent the adulteration of food materials but they are seldom given effect to. The evil is growing very rapidly everywhere and it is becoming increasingly difficult to get unadulterated stuff even in the villages. In addition to the prevention of adulteration the authorities must also discourage the import of articles used largely for such purposes.

A rigid enforcement of the Food and Drugs Adulteration Act will however only prevent the adulteration of *ghi*; it will not in any way help to increase the supply of *ghi* to meet the growing demand for it. So long as it constitutes an important item in the everyday diet, the lack of which is bound to affect seriously the health of the people, it is up to institutions like the municipalities and corporations to see that an adequate supply of this substance is produced to meet the requirements of the people within their jurisdiction. Municipalities in many parts of India have begun to take a close interest in the milk supply of their towns, and some have already taken steps to supply an adequate amount of pure milk for the consumption of the children. As is milk for the baby so is *Ghi* for the adult. *Ghi* is a product of milk and so the first step in the production of *ghi* is the production of a sufficient supply of milk. In large cities where, on account of the difficulties and high cost of keeping animals, milk supply is very inadequate, the municipality must maintain one or

more dairies at some convenient place, with rapid transport facilities. Where the municipality is unable to do this it can certainly help to promote private enterprise in this direction. A real effort on these lines is, however, urgently required in most places.

For the production of milk in large quantities and at reasonable cost three things are essential, high quality milch animals, ample supply of cheap and nutritious fodder, and cheap labour. It is a well known fact that the cattle of India are deteriorating very rapidly mainly due to indiscriminate breeding. No effort is made to breed cattle on scientific principles nor to weed out inferior stock. The cattle were, and still are, allowed to breed promiscuously with the result that the country is over-burdened with a large cattle population of very low economic value. The great majority of the people of India are interested in the problem of improving the cattle for they are the chief source of power to the greatest industry of India, namely agriculture. The soil and climatic conditions of India are all very favourable for the building up of an efficient stock of cattle in the country. What is required is a change in the angle of vision of the stock-owners themselves. It is high time that stock-owners in India should face the cattle problem from an economic point of view. Where is an old saying that it is not possible to get out of the cow more than what is put into it in the form of feed. This shows the importance of feeding and the need for raising fodder crops for improving milk production. With regard to labour there is an abundant supply of it in India; all that is required is training up in the elementary principles of scientific dairying.

THE MONEY LENDERS BILL, ASSAM.

A Moneylenders' Bill on the lines of the Bengal Bill has recently been introduced into the Assam Legislative Council by

the Finance Member. *Inter alia* the bill makes provision to enable the borrower to secure from the moneylender a true statement of accounts signed by the latter showing the amount of the principal borrowed, the rate of interest, repayments received, repayment due with the interest accrued on the same, and the amounts outstanding with the dates on which they are due. The borrower has to make a written demand for such a statement and pay eight annas fee for the expense of preparing it. If the moneylender "fails without reasonable excuse, to comply therewith within one month after the demand has been made, he shall not, so long as the default continues, be entitled to sue for or recover any sum due under the contract on account either of the principal or the interest and the interest shall not be chargeable in respect of the period of default." The bill also enables the Court to reduce interest rates wherever it is found excessive. Sub-section 4 of section 8 says" where in any suit in respect of any money lent or any security taken for the money lent by a moneylender after the commencement of The Usurious Loans Act of 1918, it is found that the interest charged exceeds the rate of 12½ per cent per annum in the case of a secured loan or 18¾ per cent per annum in the case of an unsecured loan the Court shall, until the contrary is proved, presume for purposes of Section 3 of the Usurious Loans Act 1918, that the interest charged is excessive and that the transaction is as between the parties thereto substantially unfair; but this provision shall be without prejudice to the powers of the Court under the said section where the Court is satisfied that the interest charged though not exceeding 12½ per cent per annum or 18¾ per cent per annum as the case may be, is excessive.

Original Articles

COTTAGE INDUSTRIES IN THE C. P. & BERAR

BY P. SUBBA RAO

Department of Industries C. P.

(*Continued from our previous issue*)

II. COTTON AND SILK DYEING.

Next to handloom-weaving, dyeing and calico-printing are the important cottage industries in this Province and they give employment to a large number of handicraftsmen. These are distinctly separate occupations offering immense scope for adaptation by non-artisans as principal or subsidiary occupations. Agriculturists who have leisure for several months in the year can easily take up calico-printing as a part time occupation. It does not require much training nor capital outlay. A lay worker may commence work with an investment of a small sum in blocks and other articles. Some of the simpler types of work can be learnt in a few days. Free instruction is imparted by the Department of Industries and several persons who have had no previous experience in printing have learnt the work and have started small workshops with striking success. There are several examples of printing establishments at Ellichpur and Wun in Berar, and Shohagpur in Hoshangabad district, where such men have built up an excellent trade in printed goods. The local demand for printed cloth has to be carefully studied and only such cloth as is readily saleable in the local market should be attempted at the beginning and gradually enlarged to meet the demand for printed cloth in the neighbouring districts. The printers who are now working on a large scale, and sometimes with capital amounting to Rs. 10,000 have all commenced on very modest lines with practically no knowledge of printing or dyeing. The demand for dyed and printed cloth is very great and a good deal of printed cloth is at present being imported into the province from Japan, Italy and the United Kingdom. It will certainly be possible for the men of this province to capture this trade if only they show a little initiative and enterprise. The present poverty—stricken condition of the cultivating classes can be removed by supplementing their income from agriculture by other subsidiary occupations which will

keep them engaged during their period of enforced idleness. Dyeing and calico printing are simple occupations which can be easily taken up by the agricultural classes with considerable benefit to themselves.

Dyeing in C. P.—Cotton and silk dyeing in this province is confined to two distinct classes of professional dyers locally known by the names of *Bhausar* and *Rangrez* for Hindu and Muslim dyers respectively. In the districts of Jubbulpore, Saugor and Hoshangabad, usually the Muslims do this work. In addition to the above-named districts there are a fairly large number of *Rangrez* dyers in Nagpur and Nimar districts. The Hindu dyers predominate in Berar and in the Marathi districts of the Central Provinces, namely Bhandara, Chanda, Balaghat, Nagpur and Wardha. Dyeing of cotton and silk is done to a great extent in populous weaving centres, as the dyers' output is intended for use by the handloom weavers alone. There is a third sect of dyers recently come to work in this province (and confined to the Nagpur City alone), known locally as *Multani* dyers. This last named class is more intelligent, hardworking and skilful than the above-named two classes of local dyers. To make this list as complete as possible it must be stated here that there is another class of dyers who only do garment dyeing in fugitive colours. Their number is small but they are spread all over the province. These are mostly Marwari Mohammadans.

Unlike other cottage industrial workers, cotton and silk dyers do not in practice receive any assistance from their women-folk and children, consequently some dyers employ professional labourers on daily wages. Women are not employed as the work is rather hard.

Cotton and silk yarn is dyed for the use of the handloom weavers. The raw material and the shade in which it has to be dyed is usually supplied by the weaver according to his own requirements. But some well-to-do dyers keep a stock of dyed yarn for sale to the weavers and retail yarn dealers. Such stock of dyed cotton yarn with any one dyer does not usually exceed a bale of 400 lbs. in several shades. Silk yarn is not kept in stock by the dyers as it is more costly but it is dyed for the weavers and silk merchants who furnish the raw silk and shade sample for the purpose.

There are approximately 539 dyeing establishments, and 1,617 labourers are engaged in this industry in the whole province. Nagpur district alone has about 260 establishments employing nearly 680 labourers.

Nagpur, Bhandara, and Nimar districts specialise in dyeing fast to bleach colours on cotton. They dye silk in supranol colours which are acid colours. These are sufficiently fast to washing in soap and to light. Hitherto silk yarn dyed in Sholapur district had been imported but that is entirely replaced by the products of the local dyers of the three districts above named. Cloth dyeing in naphtol colours, particularly in red, is extensively done in the districts of Jubbulpore, Saugor and Hoshangabad. This variety of cloth is known locally as *Bombai chit.* This local term has come to be significantly applied to this variety of dyed cloth because it was originally marketed in those districts by the wholesale cloth importers of Bombay.

Colours which are fast to bleaching are used only by about 80 per cent of the dyers while the rest use less fast dyes for cotton yarn. No dyer uses his own dyed yarn but the whole of his output is sold to the consumers. Thus the production of dyed yarn has no importance for household consumption of the handicraftsmen.

The output of dyed yarn.—The output of dyed yarn is gradually increasing due to the increased demand. Due to competition from mills and imported piecegoods into this province and the low level of prices for cloth, the handloom weaver has to work more to earn enough to live upon and thus the quantity of dyed yarn used by the weavers at present has increased at least by 20 yer cent of what they were using some 5 years back. Approximately about 438,000 lbs. of yarn is exported annually outside this province by the dye house of Messrs. Haji Hasan Dada working at Nagpur. There are four well established dye-houses, namely—Messrs. Haji Hasan Dada's Dye Works, Messrs. Haji Karim Noor's Dye works, Messrs. Haji Kassim Abdullas Dye works and Mr. Chandrabhan Thakurdas' Dye Works. These concerns commenced work at Nagpur about 20 years back, and before these firms commenced work no dyed yarn was sent out of this province. Besides the above four bigger establishments there are several smaller dye works. Silk dyeing is done only for local consumption, and not for export.

Raw materials in yarn.—Raw materials necessary in dyeing industry are the dye stuff and the yarn-either cotton or silk. The dyes used both for silk and cotton dyeing are imported from abroad, mostly Germany. The yarn used is entirely Indian up to 20s counts (cotton) while some quantity of yarn of about 20s counts is imported from Japan

and England. The silk yarn used is mostly the reeled mulberry silk imported from Kashmir, Mysore, Bengal and China as no local mulberry silk is available. The local silk is *tussar* which is dyed by the weawers for their own work. Imported raw materials are therefore (1) silk, (2) some cotton yarn above 20s and (3) dyes. Under raw materials of local origin may be classed the cotton yarn used by the dyers. This is purchased from the local yarn merchants by the weavers and dyers for their use and for dyeing.

Raw silk for dyeing is purchased by the weavers from retail dealers of silk at Nagpur, Chanda and Burhanpur as there is no production of mulberry silk in this province. This is the only variety of silk used for dyeing (for use as *saree* borders and for other purposes). Approximately 1,000 maunds of imported mulberry is annually used for dyeing in this province. Local merchants dealing in silk enter into forward contracts with the sole agents for sale of silk in Kashmir, Mysore and Bengal. They bring a few bales at a time for retail sale and supply the same to weavers on credit. The weavers in their turn dye the silk for their looms or get the material dyed by professional dyers. This system applies for purchase and sale of Indian silk.

The imported raw silk is almost entirely from China. In most provinces Chinese silk is gradually gaining in popularity among consumers on account of its cheapness and its evenness. This material is first purchased by big warehouses at the ports which distribute them to local merchants at Nagpur and other important places. The system prevalent is to buy for cash or on credit of one month after delivery. As in the case of Indan silk the merchants also sell foreign silk in retail to weavers, who get it dyed or do the dyeing themselves.

Next comes the other raw material, the dye-stuff, which is entirely imported into the Central Provinces from wholesale sole agents for the dye-stuff manufacturers of Germany. Messrs. Havare Trading Co. Ltd., Bombay, happen to be the only firm who supply all the dyes and chemicals used in cotton, silk and cloth dyeing. Organisation of trade in dyes and chemicals is through selling agents with sole agency rights for the Central Provinces and Berar. This sole agency for provincial sale is granted to Messrs. Tayebally Badruddin Busarai of Nagpur to whom dyes are supplied on a system of cash payment. This firm of provincial sole agents is compelled to keep a stock of all the dyes their principals may issue and sell them for cash in original packings at rates

prescribed and communicated by Messrs. Havero Trading Company. Certain rates of commission are allowed to several groups of dyes.

Markets.—Markets for sale of finished products, that is, dyed yarn, in this province are Nagpur, Umred, Bhandara, Burhanpur, Jubbulpore, Hinganghat and Nandura. There are certainly a few dyers living at each of these weaving centres as well as at such ancient places where their forefathers have carried on the trade in the past. Such ancient dyeing centres which are not important and populous weaving centres, are at present very few; they are Anjangaon, Ellichpur, Bhandara, Hinganghat and Nandura. For explaining the marketing arrangements the dyers may be divided into two groups, namely, the organised dye houses doing business on a large scale, and small scale dyers. The latter visit all the weekly and bi-weekly markets within a distance of as much as 50 miles round their home. In addition to keeping a stock of dyed yarn for sale at their own establishments the bigger dye-houses have established distributors or selling agents at other important towns and weaving centres for sale of their material, to whom they supply regular quantities from time to time. These retail dealers supply to the weavers any quantity that may be necessary, usually on credit. Messrs. Haji Hasan Dada of Nagpur alone send dyed yarn outside this province to Madras, Vizianagram, Cuttack and Calcutta. Sale of dyed yarn either within the province or outside is regulated by the popularity or otherwise of a trade mark which most of these wholesale dyers use. If a label is once favourably received in a locality the material bearing the same label will have a steady demand for a long time in preference to any other trade label. The weavers who use dyed yarn are very conservative and they are usually incapable of judging fastness or any other merit in a new yarn which may happen to come for the first time into their locality. This is how some of the bigger dye-houses hold the field against new-comers.

About two bales or 800 lbs. of dyed yarn is daily exported from this province while nearly 16 bales of yarn each of 400 lbs. in weight is dyed daily at Nagpur for sale in this province. Rs. 14,000 worth of naphtol dyes, Rs. 2,500 worth of indenthranes, Rs. 3,500 worth of aniline dyes and Rs. 6,000 worth of indgio dyes are sold monthly by local agents in this province. The total value of dye stuff sold annually in this province is Rs. 3,12,000.

Part played by middlemen.—All retail dealars in dyed yarn are

middlemen who supply grey yarn to the dyer and get it dyed in required shades, or they purchase dyed yarn from the professional dyer paying him a fixed charge as dyeing wages over and above the current cost of grey yarn. These middlemen charge a profit ranging from 30 to 40 per-cent. The material is usually sold on credit to the weavers up to a period of six months and instances of unrealisable outstandings are not few. The dyer himself has neither the capital nor does he possess the other requisite facilities for directly selling the dyed yarn to the consumers. Thus the middleman is a necessary and inevitable link between the consumer and producer. There are no middle men for selling dyes and those intermediaries who supply the dyes to the consumer do not stand in the same relation as the retail dealer in dyed yarn is to the weaver. The dyer does not borrow money for his work and he is, therefore, not able to sell his dyed yarn on credit. There is, therefore, no system of raising money by loans and no usury.

Competition.—As far as the dyeing industry is concerned there appears to be practically no competition from well-organised modern industry either national or foreign. The importance of the industry is that it has a complete monopoly in dyed yarn for all the handloom weavers of this province. There are 15 cotton mills in the province which have well-equipped dye-houses but none of them sell dyed yarn to the weavers or other traders. This is because no one shade is constant in the market as every week change is taking place in the prevailing shades employed in weaving. This is necessary to enable every handloom weaver to weave a cloth somewhat different to what he and others have till then been weaving. It does not pay the mill or a large scale dye-house to satisfy this constant change in shades. But the small-scale cottage worker possesses in this respect an advantage as he only deals in lots of 50 lbs per day. As stated above, the dyer deals with raw material supplied by the weaver and mixes necessary ingredients just sufficient for the lot to be worked. Without the village dyer the handloom weaver's work will be greatly handicapped. As stated elsewhere there are nearly two lakhs of handloom weavers and the dyers depending on their consumption are nearly 4,000. There are 290 fabric dyers who dye cloth in several shades as the occasion demands. Dyed *sarees* are used in this province and in Bombay Presidency which are supplied by local dyers using alizarine colours. This was once a flourishing industry in this province, but both the demand, and along with it the production, have considerably fallen with the result that there is practically

very little alizarine dyeing done at present and there is no export trade in dyed cloth from this province. This fact of alizarine cloth dyeing is mentioned here to explain that the tastes are changing and the workers adapt themselves accordingly. As alizarine dyeing is gradually falling into disuse the dyers are taking to the new group of naphtol dyes. Gulali *sarees* are still used in large quantities and the dyers are supplying this demand partly dyed in alizarine and partly in naphtols. Traditional requirements are very well maintained and improved upon than otherwise.

The earnings of the dyers.—The dyers earn nearly a rupee per day or about Rs, 20 per month depending on the volume of trade and the locality. The labourers employed in dyeing earn from -/4/- to -/8/- per day. The labour in towns being more costly than in villages the dyer has no other source of income.

There are several small scale dyers in towns but they are reluctant to increase their output, not because they have no capital but because they feel that the demand will not increase. The prices of yarn fluctuate, increasing the value of dyed yarn correspondingly and the rates of profits the small scale dyer is able to make on limited quantities dyed in several shades are more than the margin of profits in a factory. The cottage dyer's position is secure in turning out a variety of shades as may be required by individual weavers.

Well equipped and organised dyeing establishments of the towns are more important as the cost of dyeing is less in large quantities than in small lots. This enables the weaver to purchase raw material at a cheaper rate. The variety of shades dyed is limited and some popular shades are produced in large quantities. Although dyed yarn from towns is readily available to the handloom weaver, absence of competition is a factor helping the factory dyer to exploit the demand with cheaper and less fast shades. This is a disadvantage to the weaver whose demand is regulated by the quality of the cloth. Judged by the volume of work turned out and the organized supply of the demand, the large scale dye-houses of Nagpur are very important.

Steps taken to improve the trade.—There is a dyeing demonstrator with up-to-date knowledge of dyeing who visits the dyers and teaches them improved methods of dyeing. Use of fast colours for dyeing instead of the fugitive colours hitherto used by them is a factor materially contributing to the development of this industry. The

dyers and weavers who learnt the work are also supplied dyes in small quantities for their work through the Department of Industries. About fifty dyeing centres are annually visited by the dyeing demonstrator and about ten persons are taught improved methods of dyeing, Free demonstrations are given to the dyers and weavers with dyes supplied by the Government on the dyer's yarn. The value of dyes used in free demonstration works approximately to Re. 1 per person taught. Most of the persons who have been taught improved dyeing in fast colours continue in the work. The income of such persons has increased by at least 25 per cent to 50 per cent. The demonstrations conducted are practical with costs worked out at the current prices, and recipes for dyeing are also given to the learners individually. As a result of these efforts about 150 new persons have so far learnt and commenced work on their own account. Some weavers also have for the first time learnt dyeing their own yarn in fast colours and commenced work, thereby saving the profits of the dyer. Teaching the weavers to dye their own yarn has also resulted in their producing several new shades, thereby enabling them to improve their cloth sales.

Peculiarities of this province.—As for the peculiarities of this province in dyeing it may be stated that almost all the *sarees* used by the females of the province are coloured. They appreciate dark colours which are fast. The fashion is now changing to the uses of light colours but that is only to a small extent. At present all the coloured yarn used in the province is dyed either by the village dyer or the large dye-houses in the towns of this province.

III. CALICO-PRINTING

Dyeing of cotton yarn and printing are generally treated together. There are many points of similarity between the two cottage industries and the general conditions of the dyers apply to printers also. In this province printing is distinctly a separate industry as the printers do not do cotton yarn dyeing. This is a much older industry than cotton dyeing and requires considerably more skill. The work is very intricate and artistic, and involves greater workmanship in execution than cotton dyeing. It is, therefore, treated as a separate industry and its present condition is described below.

There are 4 kinds of printing done in this province with the following groups of colours. (1) Fugitive colours (direct and basic

colours), (2) alizarine printing, (3) chrome printing and (4) rapid fast printing.

Printing as a cottage industry is carried out by means of wooden blocks with patterns cut on them. Chrome printing and printing with fugitive colours is not fast to washing and it is employed for such cloth which is not likely to be washed. Alizarine printing is very laborious and is quite fast to wash. Printing with rapid fast colours is much faster to washing and sun-light in addition to being very easy to work with. The dyes and chemicals necessary for rapid fast printing have come into the market only recently and that is the only objection the old printers have against using these colours for printing, as in their opinion nothing new could excel the old.

The kinds of cloth printed are *razai* cloth, *jajams*, *toshaks*, *janninmaz* cloth, *lawan sarees*, *lengas*, door curtains, table cloths and blouse material. The places that have specialised in producing printed goods are Yeotmal and Amraoti in Berar, Nagpur, Jubbulpore, Saugor and Hoshangabad in the Central Provinces. The last named three districts specialise in discharge printing.

The present condition of the industry.—The production of printed cloth for the market is on the increase and particularly so in places where old methods of printing are being replaced by the modern methods and dyes. The demand for traditional types of cloth for floor coverings and quilts is maintained while new patterns in *sarees*, blouses and printed children's dress material are becoming more popular in towns. This has given rise to several new printing establisments in important towns. The increasing demand in artistically printed cloth is partly met by imports both foreign and Indian, and by new printers, while the old local printers have not had the time and the chance to learn improved methods of printing. Their conservatism is responsible for the local printers being left behind by the modern hand-printing establishment. Nearly 40 per cent of the demand in printed cloth is met by the printers of this province.

The raw materials used. — Raw materials used in printing are, the cloth to be printed either grey or bleached which is millwoven or handloom woven, and the dyes required for printing. Local printers use purely Indian cloth either mill-woven or from hand-looms. Some quantity of Japanese cloth is also used in printing. The dyes are all

imported from Germany. Local cloth is purchased from shopkeepers while mill-woven cloth is purchased direct from the mills or through local distributors.

Markets.—Markets for printed cloth are within the province itself but a small quantity of cloth goes out to the adjacent districts in the Bombay Presidency, Hyderabad, and the Central Provinces states. The printers are given orders to supply printed *sarees* or some other material by the cloth merchants at prevailing market rates. These orders are executed by the printers who receive payment upon delivery. The merchants sell this printed material in that town or send out a part to thier customers in other districts. The printers know the local demand of the cloth merchants dealing in this kind of cloth and print some quantity in anticipation of orders. As soon as the cloth is ready, a sample is taken to the merchants and offered for sale. On arriving at a reasonable price the printer hands over the goods and receives payment. This is the case among well-to-do printers of Shohagpur, Anjangaon, Wun, Hatta, Garhakota and Rahatgarh. The merchants have established customers for these popular varieties of printed cloth and dispose of the material to them. The majority of the printers who are not rich enough to invest large sums of money, print about 50 pieces of all varieties and take them to the weekly market for sale, or hand them over to the trader for a reasonable price. In such cases the merchant sends out the material to different districts and to the adjoining districts of Bombay and Hyderabad. There is no export of printed cloth outside India.

Middlemen. — Assuming that middlemen are those who conduct business in printed goods between the primary producers and the consumers it may be stated that there are middlemen in the marketing of printed cloth. These middlemen advance cloth for printing if a favourable rate for dyeing and printing is possible to get from the printer. The printer, if short of work, accepts in some cases any rate the merchant may offer and executes the work. In such cases he gets 0-4-0 per *saree* less than if he sold direct to the merchant, but he does not as a rule accept such orders. The merchant takes high profits on the sale of printed cloth by making it somtimes very dear for the consumer. The consumers naturally purchase the cheaper products of the mills. Some printers raise loans for purchase of cloth and pay back after the whole amount is realised. Such loans are given by professional

money-lenders who charge heavy rates of interest; without adequate security no loans are granted to these printers.

Competition of machine-printed material.—Hand-printed cloth reaches the consumers at a higher price than machine-printed cloth. Machine-printed cloth is less artistic and less durable but its cheapness is the only factor contributing to its acceptance by the public. Machine-printed cloth is confined to towns and important trading centres. It has not yet gone to the village markets as the traders do not find it profitable to purchase it in towns and sell it in the interior villages instead of the hand-printed material which is available in the locality. The village printers do not find a demand for their products in towns and thus machine-printed cloth meets 60 per cent of the demand in printed goods of this province. The hand-printers, out of sheer dogmatic conservatism are not adopting either the new colours or improved methods of block-printing, or their heavy designs, to suit the modern changes in popular taste. On this account some of the printers have had to leave their profession for field labour and other occupations. On the other hand several new establishments have come into existance in towns to meet the changed taste of the consumers in finer designs and lighter colours in printed goods.

Village printers are maintaining strictly traditional standards in workmanship and patterns. They also purchase suitable raw material for the kind of goods they produce. It remains to be seen how far the printers dogmatic adherence to old standards of workmanship and material will bring them prosperity or ruin as there are many printers of good standing still thriving on this work. It is but reasonable to assume that the less skilful and persevering craftsmen have dropped out, giving place to the advocates of modern methods of work. Judging the present position of the printing industry from all aspects, it should be stated that there is good scope for improvement on rational lines. It is not possible to lay down any hard and fast rules but systematic competition from machine-made articles has the effect of opening the eyes of the village printers to the change in public taste in favour of less loud colours and delicate patterns.

Organisation of work.—The work of calico-printing is done by the members of the family in their own house. If there is accommodation the work may be done in a separate room or on the verandah. The principal earners are the men while women also do the work along with

men or independently as the case may be. In some families women do the work of actual printing and the man goes out to sell the finished product and purchase the raw material. Four to eight *sarees* each measuring 45″ x 9 yards, are easily printed in one day by a single worker if the printing paste and cloth are ready for work. Well-to-do printers give out work to women to do in their own cottages and remunerate them at fixed rates of wages per piece. A particularly difficult work is not given out but is done under the watchful guidance of the principal printer. All the assistants employed by rural printers are paid wages at piece rates. There is no system of remunerating paid assistants by monthly wages. The proprietor of a printing establishment is himself one of the workers and he also supervises the work of others. There are very few establishments where workers are paid monthly wages. Only well tried workers are allowed this privilege of working on monthly pay. This is done in towns and in some of the modern printing establishments. Wages of paid assistants range from Rs. 15 to Rs. 18 a month. Piece workers earn as much as Rs. 20 to Rs. 25 a month during the busy season and Rs. 10 to Rs. 12 a month during the other periods. Women and children are also employed as paid assistants on piece work and as a rule all the printers work from eight to ten hours daily.

Printing of cloth is not done during the rainy months as the water remains dirty and there is not sufficient sun to dry the cloth. The printers do no other work. Theirs is quite a healthy occupation as there are several operations supplementary to actual printing which have to be done in the open air.

The earnings of the printers.—Calico-printers and paid assistants of printers earn quite a decent income as compared to agricultural labours and small agriculturists. It is only a great slump in the printing trade or such other adverse circumstances that will induce a printer's assistant to change his occupation for any other. Rural labourers are practically without work for about six to eight months of the year while the workers engaged in printing are idle, or partly so, for only four months in the year when printer's work is slack and during that season there is plenty of out-door work available for those who like to take it. Some workmen do usually take up agricultural work to maintain themselves as they do not or cannot effect a saving out of their wages at other times.

Attempts to improve the industry.—Demonstrations in improved methods of printing with better blocks and colours are conducted in populous printing centres. Printers' assistants are given regular training in the use of better colours and blocks by the Department of Industries through paid assistants. Cheap colours, chemicals and blocks are sold to the printers at cost price. Some new designs carefully executed and well tried in the market are being given to the printing establishments for reproduction on commercial lines. House-to-house demonstrations and propaganda are conducted at places visited by the printing assistants. As a result of this propaganda some new establishments have come into existence and they are earning between Rs. 150 to Rs. 200 per month each by the judicious handling of an initial capital of Rs. 2,000.

(To be cotinued).

FRUIT CULTURE*

By B. R. Phatak, B. Ag.

Soils.—Chief among the desirable physical characteristics in an orchard soil are porosity and thorough aeration coupled if possible with depth. With such soils tree roots often penetrate to a depth of 20 feet and ordinarily, to a depth of 6, 8, or 10 feet. In Rhine valley grape roots have been traced 15 meters ($48\frac{3}{4}$'). Certain arid soils of California are well suited to fruit culture because surface soils grade invisibly into the subsoil and the latter is well-drained and thoroughly aerated. Roots in these soils penetrate deep and sustain the plant when the surface soil may become too dry. That good drainage, and its corollary good aeration, are associated with this condition is indicated by Hilgard, when he states that with the rise of the water table through injudicious irrigation, trees that had thrived may actually suffer, much as those planted in shallow soils or soil underlaid with an impervious hard pan, and from practically the same causes. Speaking of soil aeration for the *papaya* Higgins says there are few soils in which *papaya* will not grow if aeration and drainage are well supplied. The same

* The following books have been freely used in preparing this note.—

"Fundamentals of Fruit Production" and "Drcharding"—Gardner Bradford and Hooker.

"Science and Fruit Growing"—Duke of Bedford and Spencer Pickering.

"Tropical and Subtropical Fruits"—Popenoe.

"Citrus Fruits"—Coit.

"Gardening in the Tropics"—Woodrow,

writer says of bananas that there are two essential features of a good banana soil, the first, abundant moisture, and the second good drainage.

There are however marked differences between species and varieties of the same species in their preference for soils of unlike textures. The pomegranate is reported as doing fairly well in soils ranging from almost pure sand to heavy clay, but it does its best only in those that are purely heavy and well drained; however it will endure a wet, poorly aerated soil much better than any other fruit. It may be said here that the soil that may be best suited for a particular variety in one section may not be best in another section with different climate and distinct environmental conditions. It may be said here in general that the more favourable the texture of the soil for the lateral and vertical development of the root system the better.

Depth of soil.—Theoretically the soil need only be half as rich as another in order to support equally well a certain amount of vegetative growth if it is of such a character that the roots penetrate twice as deep. Further, since water is a limiting factor as often as plant nutrients, a tree with deeper root system, though in poorer soil, is really in a better position than one growing in a richer but shallower medium. Only under very special conditions should ordinary deciduous fruit trees be planted in soils in which roots cannot penetrate freely to a depth of 2½ feet to 3 feet in humid regions and to a depth of 5 feet to 10 feet in arid and semi-arid regions. Shallowness of soil, hard pan, plough sole close to the surface, impervious subsoil and poor drainage are inter-related factors which check vegetable growth, reduce yields and the size, quantity and the grade of the fruit, favour irregular bearing and lead to numerous physiological troubles, the treatment of which is very difficult. Mechanical analysis and chemical composition of the soil are of second importance to these. Correlation between the soil composition and the actual response of the associated trees to additional fertilization is either slight or absent entirely. The soil is a very complex substance and likewise is the soil solution. Apparently absolute amounts of certain elements or compounds that it contains are not so important as the state of balance or equilibrium existing between them.

It is generally easier to modify the soil than the subsoil. The subsoil must be taken largely as it is found. Consequently in selecting a piece of land for fruit growing, the subsoil should be given a specially

careful consideration, particularly as regards its physical conditions. Both physical and chemical conditions of the surface soil can be modified materially, but to effect any considerable change particularly in physical character is expensive.

Experience in the College orange garden has shown better drainage to be more effective than attention given to manuring. Practically all fruit trees are alike in requiring considerable depth, thorough aeration and freedom from plough sole and other impervious strata.

Propagation.—Fruit trees are propagated from cuttings, layers, stools and the like, which depend upon the formation of the roots from the wood, of the variety to be cultivated without the intervention of grafting or budding. In India figs and grapes are propagated from cuttings. Pomegranates could also be grown from hard wood cuttings. Lemons could be grown by stooling and gootying. *Sapotas* are, by some, reported to grow freely from cuttings and layers. They do not succeed in Nagpur in striking root even in gootying. Other trees propagated from cuttings or layers are Jujube (*Ber*) and Carissa. Many fruit trees in tropics are raised as seedlings. Bananas and dates are raised from suckers, the latter also as seedlings. For getting line types some of the fruit trees are propagated by grafting and budding on other roots.

Propagation from cuttings is really a cheap process, but the plant may do better on some other roots than its own. Objection is sometimes made to plants propagated by cuttings as compared with those developed as seedlings because of certain supposed shortcomings. They are occasionally said to be shallow rooted. Hatton however finds it easy to raise stocks of deep anchorage by layers and other vegetative methods and contends that shallow root stocks are often met with in any collection of free stocks raised from pips. Cuttings have certain marked advantages in propagation; they produce uniform roots, which is of considerable importance. The constant tendency to variation in seedlings is not confined to quality, colour and size of the fruit but extends to every character of the plant. The quality of the fruit varies no more than the stature; the depth of rooting, resistance to cold, drought, moisture, alkali, all are variable characteristics.

The seedling root is in a measure an unknown quantity. The tree planted in the orchard is standardized above ground and uncertain below ground.

Examination of an orchard injured here and there by root killing forces the belief in the variation shown by the seedlings roots and an appreciation of the desirability of stock which is uniformly hardy. If a vigorous hardy stock could be isolated and propagated much of the unevenness in yield and uncertainty in hardness would be eliminated.

There is a belief among different workers on the continent of Europe that the seedling trees have a greater longevity than those raised from cuttings. Grapes, gooseberries and currants have passed through many generations of cuttings without perceptible diminution in vigour. This process could not thus be called devitalising.

Effect of stock on scion.—Many trees grow better on other roots than their own and it were better that such were budded or grafted on other stocks whose roots are more congenial to them. The stock and scion are believed to have various kinds of influences on each other when grafted. The influence of the stock on the scion is without doubt quantitative rather than qualitative in character. The stock influences the vigour and the form of growth. There seems little reason to doubt some influence of the stock on the termination of the growing season, which is after all only a phase of the vigour. If the effect of stock on vigour is accepted, all other influences of stock on scion can be explained through that one influence. None of these influences differs from the effects that might be secured from so modifying cultural conditions as to modify vigour. Cultural conditions can be changed to induce early fruiting or late growth or earlier ripening or hardness or disease resistance or increased fruit bud formation or better setting of fruit or larger or better ripened fruits. Girdling of grapes will increase the sugar content and size of the fruit. The dwarfed trees of China that bear inferior undeveloped fruit are on their own roots. The inferiority of the fruit is brought about by manipulation, not by any influence of stock on scion.

The influence of stock on scion is not to be ignored; much harm has come from it. Frequently it is of extreme importance. However it is important to the scion only as its vigour is to the scion, and as the grafting union is satisfactory. The scion for adjustment to one locality or purpose may require a vigorous stock; for adjustment to another locality or purpose it may require a less vigorous stock or one that thrives in a soil of a peculiar character. The adjustment of stock to scion should then be made with soil, pests and cultural practice in view ;

conversely these may be considered in their relation to the stock as well as to the top.

In the case of oranges it is believed that oranges budded on sweet lime give a sweet and tight-skinned fruit while those on *Jamberi* (sour lime) give sour fruit with a loose jacket. This however has not been borne out by experimental proof. Neither the tightness or looseness of the jacket nor the sweetness are known to be associated with the stock. It has been borne out that the *jamberi* and pomelo as stocks give a great vigour to the *santra* scion, and proper vegetative growth. It also controls the maturity to a certain extent and this accounts for early sweetness due to early maturity. There are some bud and seasonal variations in the Nagpur *santra*. They have however no relation to the stock on which it has been budded.

Effect of the scion on the stock.—Scion also has an effect on the stock. This is not readily marked in fruit trees because the interest of the fruit grower is centred chiefly on the scion and minor influences on the stock are less likely to attract attention. Furthermore an influence of scion on stock might involve a reaction on the scion and so be attributed to the effect of stock on the scion. In this case the result is in the direction of the vigour and form. Sahut says if a scion belongs to a more vigorous species or variety it stimulates the vigour of the stock. Whether the cause be incompatibility, poor graft union or something else there is apparently sufficient evidence to warrant the statement that in some cases the scion does influence stock. Since pruning the top of any tree regardless of the stock tends to reduce the root system and since some dwarf trees are kept so only by heading them back, a top which will not grow vigorously may be expected to act on the stock as would a heavy pruning. A top which is able to supply the roots with abundant food may be expected to increase their growth. The scion has been known to produce an effect on the longevity of the stock, making an annual stock live for three years and more.

Just as in the case of the effect of the stock on the scion the effect of the scion on the stock is in the direction of vigour. Every other influence that has been established or attributed can be explained as exercised indirectly through vigour and can be placed on a quantitative basis. This action on vigour may be direct when the two parts of the graft are congenial and make a good union or it may be indirect when there is apparent uncongeniality and the union is poor. Qualitative influences such as

the passage of the alkaloid across the graft or the barring of innulin by graft are not necessary to accept any observed phenomenon resulting from grafting on fruit plants.

In the case of a stock that brings about greater fruitfulness on the scion it is easy to believe that such a tendency will hasten the death of the plant.

Time of budding and grafting.—Budding and grafting should be done when the buds are dormant. This is usually found in all trees in October-November and it is therefore the best time for conducting these operations. Citrus stocks may be budded whenever the bark slips.

Double working means grafting or budding again the plants which had previously been grafted or budded. The purpose of double working varies with the material.—(1) to bring an intermediary for causing satisfactory union and (2), to secure the desired properties found in a species not making satisfactory union.

Planting.—The usual method adopted in planting fruit trees is to dig pits of sizes varying with the kind of the plant to be planted, mixing with the earth dug out equal amounts of manure and filling the pits with this mixture and allowing it to settle down for a month or two. The plant is then removed and planted out in the centre of the pit and well trampled down. Experiments were conducted on the Woburn fruit farm to investigate the best method of planting and the results were found in favour of rough planting. In this rough planting the ground was not trenched, the roots of the trees were not trimmed, they were huddled into small holes and then rammed into the ground. The branches of the trees however were cut back, and they were in every respect other than the method of their planting, treated in the orthodox fashion.

Though these trees when compared with their carefully planted fellows in the neighbouring plots showed some deficiency in leaf vigour especially during the first year after planting, they showed an excess of vigour both as regards number of shoots and the length of new wood formed, the excess of the latter amounting to 31 per cent in the second year. The tress lifted 3 years after planting and weighed showed considerable balance in favour of those roughly planted, ranging from 17 per cent upto as much as 417 per cent.

The three main items of rough planting were examined separately :

(1) The ramming of trees forcibly in the soil, a heavy rammer being used for the purpose, and the process continued till the soil was puddled and shook like jelly.
(2) Leaving the roots untrimmed or injuring them abnormally by hacking them with a spade.
(3) Huddling the roots together into a small hole the majority of them pointing downwards.

Deliberate injury to certain fractions of all roots, these fractions amounting to from one-tenth to seven-tenths of the whole length of the roots shows that the curtailment of the roots by removing from two to four-tenths of the whole length generally results in no injury to the tree indeed from some points of view a little benefit-but that when this limit was exceeded the growth was adversely affected. This and the balling of the roots together showed no gain no loss. The favourable results of rough planting had therefore to be attributed to the ramming forcibly of the plants into the soil.

Effect of ramming.—The seat of growth of the root system of a tree is situated at the tips just behind the rootcap and no extension of the root system can occur if the root tips have been destroyed ; but in lifting and transplanting a tree, however carefully it may be done, the majority of the root tips, which are very delicate, become broken off or dried up by exposure. The continued existence of the tree is therefore dependent on the formation of a fresh supply of roots actively growing rootlets which, under favourable conditions, are developed laterally either from special cells in the existing roots or, in some circumstances, from the base of the stem itself and the transplanted tree is thus saved from death. The conditions essential to the formation of these new rootlets are moisture and intimate contact with the soil. The latter is secured more effectively by ramming than is possible in any other way and hence the beneficial effects of this ramming.

Depth.—Experiments were conducted at the same fruit farm with reference to the depth of planting. Plants were planted 6″, 12″ and 24″ below their original level. The results in this case were different with different stocks. They were highly in favour of planting 24″ deep in Paradise wild apple stock but against it in the case of pears on quince stocks.

Planting systems.—Three of these are adopted in practice. They are the square, the *quincun and the hexagonal (equilateral triangular). In the square system all trees are equivalent from their neighbours in two directions. In the quincunx each tree is in the centre of a hexagon of a not regular character. In the hexagonal or equilateral triangular system any three neighbouring trees in it form an equilateral triangle. In the hexagonal system each tree has the same amount of room in all directions for the development; it is however not convenient for cultivation for the alleys between the trees are always narrow. The laying out also is not a simple process. The effect of these different systems on the crop borne was not shown owing to adverse effects of pests etc. The weights of the trees when these were lifted eleven years later had to be taken as expressing the results. The actual distances between the trees were-square arrangement 6 feet, rectangular 4.24 and 8.48 feet, hexagonal 6.53 feet.

	Weight of trees.
Square ...	... 100
Rectangular	... 100.7
Hexagonal ...	... 101.7

The differences were inappreciable and difficulties involved in cultivation in the hexagonal arrangement were too many to warrant its adoption.

	Planting distances.
Mango grafts	... 35' 20' (according) to wood row.
Seedling ...	... 40', 45'
Guava ...	... 10', 15' (according to Pohenoe 18', 24' (India).
Oranges Navel	... 22'
Santra...	... 20'
Pomeloes ...	... 24'
Lemons ...	... 12', 15', 18'
Sapota ...	... 15', 20', 30',
Sugar or custard apple	... 15', 20',
Papaya ...	... 8' 10',
Banana ...	... 4', 5',, 8', 10',
Jackfruit ...	... 25'
Jujube Ber	... 15', 25',

* Number of trees to the acre.

These varying distances are adaptable in different soils and climates.

Distance apart.	Quincunx.	Hexagonal.	Square.	Tringular.
35' x 35'	65	41	36	33
30' x 30'	83	55	48	44
25' x 25'	126	81	70	60
25' x 20'	...	...	87	79
24' x 24'	137	86	76	...
22' x 22'	173	103	90	...
20' x 20'	199	126	108	98
18' x 18'	247	142	134	122
20' x 15'	...	...	145	132

Time of Planting.—Trees may be transplanted when they are as nearly dormant as possible.

(*To be continued.*)

FAMINES IN INDIA.*

By A. M. Chaudhary

Senior B. Ag.

Famines, to-day, have lost much of the severity and horror that were once associated with them in India. Thirty years ago famine was the nightmare of the country, of the people, and of the Government. Preparations to withstand the visitations of famine constituted one of the chief functions of the executive of the Government and people lived under the constant fear of a coming catastrophe. In the past, when famine visited the land it was a terrible time for the country. Land went out of cultivation, trade and industry were paralysed and people died in thousands for want of food. Sometimes it lasted only for a few months; at other times it continued for one or two years or even more, and then the condition of the country was miserable.

* Class essay.

History of famine.—Descriptions of famines are found in Sanskrit and Pali literature. During the Hindu period famines used to occur occasionally as if to put the people on their guard. The Mahomadan period is said to have experienced famines but rarely; and it is claimed that there were only four famines during a period of 500 years.

In the last quarter of the nineteenth century famines began to visit India more frequently than ever and with the political awakening of the people serious attention was paid to these calamities. The severity of famines was ascribed to the industrial, financial and land revenue policy of the Government. This view is based on the supposition that famines were few and far between in the pre-British days. Another view was that famines were due mostly to failure of rains and also to certain other factors beyond the control of the British or any other Government.

History reveals that the famines of pre-British days were in no way less severe or frequent than those that occurred afterwards. In the famine of 1291 families drowned themselves to escape from starvation and in the famine of 1555 people tried to live on the hides of dead beasts, and the famine of 1630 actually led to cannibalism.

Coming to the British period the most important and disastrous famines occurred during 1877-1878, 1889, 1892, 1897, and 1900. The famine of 1877-78 is thus described by the Famine Commission of 1880:- " The great famine in Southern India which has so recently come to an end, has been, in respect of the area and population, and the duration and intensity of the distress, the most grievous calamity of its kind experienced in British India since the beginning of the century." The total area which suffered from famine in Southern India during 1877 was about 200'000 sq. miles with a population of 36 millions. In the next year an area of 52,000 sq. miles in the North-Western Provinces and the Punjab with a population of 22 millions was affected by a failure of the rains though it suffered to a far less degree. It has been officially estimated that the mortality that occurred during the famine of 1876-78 amounted to $5\frac{1}{2}$ millions in excess of the normal rate. The number of births, which generally receive a check during a period of starvation and distress, was, it is estimated, reduced by two millions. The total reduction of population by death and by loss of fecundity is accordingly computed at 7 millions. The total expenditure on the famine of 1876-78 was about 11 crores of rupees.

The famine of 1891-92 was very devastating in as much as it affected an area of 50,000 sq. miles with a population of 7 millions. The maximum number daily employed on relief work was 2,40,000 and the total cost including special establishment charges loans, remissions of revenue, etc., exceeded a crore of rupees.

The Nineteenth Century did not experience a more severe shock than it did from the famine of 1896-97. The total affected area in British territory was about 225,000 sq. miles populated by 62 millions of souls. The percentage of average daily number relieved to the total population varied from 5. 3 in Bengal, to 14.8 in the United Provinces. In Madras it was 12.9; in the Ceutral Provinces 10.3 ; in Bombay 12.1 and in the Punjab 9.3 in the most severely affected tracts.

The famine of 1899-1900 came at a time when the country had hardly recovered from the miseries and sorrows inflicted by the preceeding one and it threw the country into a condition almost beyond recuperation and it took many years to restore its normal condition. The population of a fair sized European country has been swept away from India within twenty five years.

Famine relief policy.—Prices of articles in the famine stricken places rise abnormally high. Government has no alternative but to prohibit export from those places and encourage import. But since 1812 Government ceased to interfere with trade. Relief works were first opened in 1792 but the recognition of the obligation that work should be provided to all who seek for it came as late as 1838. The helpless and the infirm were left to themselves and could only seek relief in public charity. During the period following the transfer of India to the Crown there were no less than a dozen famines resulting, presumably, from disorder and chaos due to war and consequent disorganisation of administration and trade. A serious attempt was made to advance relief which passed through many experiments of failure.

The famine of 1860 that wrought havoc in Northern India demanded relief measures and to this end people were divided into three classes:—(*a*) those capable of work in the large undertakings, (*b*) those who really deserve charity but from whom, for moral reasons, work was demanded in the poor houses in which they were fed and, (*c*) those who could not stir out of their houses due to caste difficulties and were fed on individual charity.

Government appointed a commission headed by Sir Richard Strachy and on the basis of the recommendations of this commission elaborate arrangements of relief were set afoot in India. There were no less than three Famine Commissions appointed during the period 1868 and 1907. All of these recommended almost on the same principles.—

(*a*) That the able bodied on performing a reasonable task shall have wages sufficient to live.

(*b*) That people unable to work should get gratuitous relief at home or in poor houses.

The second commission recommended a more liberal wage and free extension of gratuitous relief. The third wanted some modification in wage scale and recommended the necessity of "putting heart into the people."

The Government of India made provisions for 1½ crores of rupees to be spent when necessary for relief work and to be utilised in public works of a protective nature in normal years. *Takkavi* loans were advanced. Land revenue was suspended or remitted. Famine codes embodying relief principles were made for every province but had to be modified slightly in subsequent years to be compatible with the conditions and circumstances.

Economic effcets of famine.—The effects of famines are bound to be disastrous in an agricultural country like India. Modern famines unlike old ones are not so horrible owing to the various measures adopted to minimise the effect. But the lowering of efficiency in famine-stricken people resulting from starvation was an inevitable effect. Agricultural operations were hampered due to fodder famines which accompany food famine. There is also an adverse reaction on trade and industry because of the reduction of the purchasing power of a large number of people. Government is hit hard both on the side of revenue which invariably shrinks, and on expenditure which equally inevitably expands.

Causes of Indian famines.—Superficial explanations have been offered one after another and many also have been rejected on close examination. It was said that population increased rapidly in India and such increase when it exceeds food supply leads to famine. There are various causes contributing to famines in India.

(a) *Economic cause.*—Prof. S. C. Roy maintained that the causes of famine lie in the want of money rather than in the want of food.

People are so hard pressed that they cannot save for unforeseen bad seasons and when there is a failure of harvest famine appears with all its calamities.

(b) *Physical causes.*—The chief cause of famine is deficiency or total failure of rain. The famine Commission of 1880 pointed out the root cause of famine to be "the unfortunate circumstance that agriculture forms almost the sole occupation of the mass of the population." Sometimes excessive rainfall resulting in devastating flood is responsible for famines ; sometimes also insect pests and fungus diseases.

(c) *Modern civilization.*—According to certain critics of Mr. R. C. Dutta's "Open Letters", the cause of famines in an old-world country like India is the introduction of modern civilization which is continually expanding extremes in the country, making the rich richer and the poor poorer.

(d) *Excessive land assessment.*—Excessive land assessment in the past took away the resisting power of the people against scarcity and famines.

Remedies.—Irrigation and good communication facilities mitigate the ravages of famines to a great extent. When there is scarcity of rains its adverse effect can be well combated by irrigation. In times of dearth of food, transportation by railways and steam ships can pour in food materials in large quantity to places where they are needed.

(b) *Preservation of forests.*—Rain is precipitated by coming in contact with the cool atmosphere created by forests over a considerable height.

(c) *Development of agriculture and industries.*—About 75 per cent of the population of India depends upon agriculture. It is therefore incumbent that agricultural industry should be developed by introducing scientific methods of agriculture. The development of industries brings about prosperity in the country. The establishment and fostering of these industries have been made highly possible by the Co-operative Credit Societies Act of 1912. Prof. Roy says:—"The improvident habits of the ryot drove him into indebtedness with the consequence that his power of resistance in times of stress became weak." As a solution of this problem he advocates the restriction of a tenant's rights to alienate his land and the growth of co-operative credit organisations. Prof. Kale suggests that "more capital, more industry more work and greater efficiency and productivity are the essential conditions of success

in the fight against famine. A change in Indian administrative system is necessary. Some power should be given to the village institutions so that it may help to avoid unnecessary litigation.

Government's remedial policy.—The fact is that it is not in the power of any to prevent drought in India or, so long as the country is mainly agricultural, to prevent drought from causing famine. All we can do is to restrict and mitigate the resulting suffering. Government are always prompt in action to cope with the ravages of famines. They also make elaborate arrangements for relief.

Takkavi loans are offered to the cultivator. Non-official help is sought. A list of persons requiring urgent relief is prepared and relief officers are at once deputed to meet the needs of the distressed people.

Famine Insurance Grant has been started in almost all the provinces of India, providing a large sum to be distributed when warranted by actual outbreak of famines.

Famines in the old sense are now a thing of the past. Scarcity of rain no more results in scarcity of food. Irrigation facilities are not wanting in places where rainfall is uncertain. Communications and easy methods of transport have minimised the danger of famines. In short, present day famines are famines of money and not of food.

Extracts

THE VALUE OF SCIENTIFIC RESEARCH TO AGRICULTURE*

BY HENRY A. WALLACE,

U. S. Department of Agriculture

If you have though about mankind's struggle through the ages to build an orderly society, you will agree that there have been two primary problems; first, to produce enough food and fibre to feed and clothe us all; second, to divide what we produce as equitably as possible.

We have always had to be concerned with production. Whatever else man can do without, he cannot live without food. And that was no simple

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problem back in the days when men lived in tribes in the forest, and when the food supply depended upon a man's skill with crude weapons. When the first faint stirrings of commerce and industry drew men to live in large groups in cities, the problem of a food supply became even more acute. Those who lived in the ancient cities could not grow their own food and fibre. Those who remained on the farm had the new job of growing enough not only for themselves, but for other families in nearby cities. Thus the dependence of the city dweller upon the farmer is overwhelmingly real. It is the key-log in this structure we call modern civilisation.

And there were times when the structure was in danger of collapse, or indeed did collapse, because the key-log weakened and gave way. By reason of abnormal seasons, drought or food, famines came and wrecked whole segments of human society. It was customary to blame those catastrophes on nature. Man, week creature, was powerless if nature chose to starve him or drown him or otherwise maltreat him.

Somewhere back in the ages, a few individuals, more daring, more imaginative then the rest, began to wonder whether that was true. They reasoned that though nature could not be ignored, it could be modified. Man began doing that, when he learned how to make fire by rubbing sticks together. We have been modifying the behaviour of nature ever since, to prevent famine, flood and other disasters, until, as Julian Huxley puts it, man has done more in five thousand years to alter the biological aspect of the planet than nature has done in five million years. By putting nature in harness, so far as possible, we have solved mankind's first great problem—the problem of producing enough food to go round. We have solved it too well, as a matter of fact, but I shall speak of that later.

When it is possible for the farmers of a nation to increase production 50 per cent. while crop acreage is increasing only 25 per cent. we know that science has been at work. That is exactly what has happened in the United States during the past 30 years. In large part it is a result of the scientific work of the United States Department of Agriculture and the co-operating State institutions.

It was for the purpose of putting sicence to work in agriculture that this Federal Department of Agriculture was established by Act of Congress 71 years ago. Washington, Jefferson and Franklin saw the need for it even back in their day. The department was created primarily for scientific research, its main job always has been a research job, and I hope research will always remain a principal duty.

Of course it is not enough to discover facts ; a public institution has also

the obligation to see that the facts are made available to all who can profit by them.

When a plant breeder in the department develops a variety of wheat that is highly resistant to rust, the job of the department has not ended with that discovery. The new variety has to be tried out in various regions, in the field. Next, the results of those trials have to be made known to wheat growners. That involves publications both technical and popular, and articles for the press, and radio broadcasting. Then the seed of the new variety has to be made available to farmers. The country extension agent may step into the picture at this point and suggest that the interested wheat grower sow some of the new seeds in a test plot, alongside some of the seed he and his neighbours have been using in the past. And when the old and new varieties of wheat are up and are harvested, let the neighbours for miles around come in to compare them, and decide whether or not the new variety is better than the old and worth investigating.

That is a thumbnail sketch of the way science is applied to agriculture in this country and it portrays a system that is the envy of many another nation. Sir Horace Plunkett, Ireland's great authority on agriculture, in 1928 was moved to describe the Department of Agriculture as "the most widely useful department in the world." I am inclined to agree, and I only hope that its future will be as brilliantly successful as its past.

Whether he knows it or not, every farmer in the United States is farming differently today—and better because of the scientific discoveries resulting from State and Federal appropriations. The average hour of man labour and the average acre of land is undoubtedly, 20 to 30 per cent. more productive today because of this scientific work. From the fundamental point of view—that of supplying the food and fibre needed by our modern civilization—the millions of dollars spent by State and Federal agencies during the past generation have been abundantly worth while.

I appreciate that it is often difficult for the layman to see any earthly use in many of the things that scientists do and talk about doing. Of what value is it to you and to me, for instance, for a man to spend his time trying to discover the workings of nature ? How can a man—we are inclined to say—do anything useful unless he works directly with the things that we all can touch and see, that we know have practical utility ?

Well, when confronted by questions like that, I think of men like Faraday and Mendel, and some of the scientists in the employ of the Federal Government. About a hundred years ago in England Michael Faraday was

what we might call an experimental philosopher. He never concerned himself with the invention of machines. His sole aim was to learn something about the workings of nature. He discovered the principle of electro—magnetic induction, and if you remember your high-school science, you will recall that without that discovery, we would today have no means of putting electrical energy to work for us. Without Faraday the amazing inventions of Edison and Marconi would not have been possible, and your radio and your electric lights would not exist.

And Mendel, that cloistered Moravian monk who whiled away the hours studying plants and experimenting with the cross-breeding of varieties of garden peas—of what earthly use was all that ? He did it because it interested him. But was it of any use to the rest of us ? I can assure you that it was, for the principles he discovered have been employed by the plant breeders of today in developing more productive varietis of every plant that feeds and clothes you. Scientists like Mendel and Faraday were working in what we call pure science. They were trying to discover nature's fundamental secrets but without thought of any practical avocation of their discoveries. Had some over-zealous administrator tried to restrict their curiosity to some specific object, or the immediate solution of some highly practical problem, we would have been deprived, in all probability, of their great discoveries.

It falls upon another group of scientists to apply these basic principles to the pressing problems of the world and turn them to practical account. Thus most of the scientific research in Government departments is applied science. The surprising thing, however, is that even in the field of applied science far-reaching discoveries are made, often as a by-product of the immediate task.

One of the most famous examples was the discovery by the scientists in the Department of Agriculture some forty years ago, that a micro-organism found in the blood of cattle is the cause of splenetic fever, and that the disease is transmitted by the cattle tick.

During the years 1888 to 1893, four men spent most of their time trying to make that discovery. Splenetic fever had become a costly disease of cattle throughout the South. Home-made remedies, treatment by skilled veterinarians, alike proved futile. The disease was costing the livestock industry, and ultimately the consumer of meat, many millions of dollars.

The four Department of Agriculture scientists, in the employ of Government—because they wanted to pursue scientific research without interruption, and at salaries sadly out of line with their worth to the nation—these men

kept doggedly on the job despite all sorts of obstacles and disappointments. The joy of achievement was their chief reward. And their achievement proved to be of lasting benefit not only to the livestock industry, but to all mankind, for their research was the first demonstration that a microbial disease can be transmitted exclusively by an insect host or carrier.

From that came the knowledge, at the hands of other scientists, that yellow fever, malaria, sleeping sickness and other maladies are similarly transmitted. From that flowed the successful control of yellow fever, for instance which in turn made possible the building of the Panama Canal. So it can truthfully be said that the success of four Department of Agriculture scientists in discovering the cause of a cattle disease was a first step in the construction of the Panama Canal.

These scientists—by name Theobald Smith, Curtice, Kilgore, and Salmon—of course had no idea of the far—reaching consequences of their discovery. They were intent on finding the cause of a cattle disease, not in discovering a fundamental principle in medicine. But that happens often in scientific research.

And at other times, a scientist may fail to solve one problem, only to solve another unexpectedly. Not long ago some chemists in the Department of Agriculture were examining moulds—fungus growths, that is- -to find one that would produce tartaric acid. Patiently they tested one after another, until they had exhausted the possibilities of 149 different moulds.

Finally the 150th rewarded their long search with success—but not the success they were expecting. Instead of producing tartaric acid, the 150th mould unexpectedly produced gluconic acid. This is now used in making calcium gluconate, the only calcium salt that can be injected between the muscles, without causing abscesses, in treating certain human diseases. This salt used to cost 150 dollars a pound. As a result of this research, it may now be had for 50 per cents a pound.

Much of the scientific work of the department, however, calls for more than the ordinary equipment of a scientist. I am thinking of the plant explorers, the men who cut their way through treacherous jungles, or press on across the forbidden deserts of Mongolia in search of plants that we need here at home. Whenever you eat bread made from durum wheat, or enjoy a choice steak or pork chops from cattle or hogs fed on alfalfa and soybeans, or sample a package of dates or a crate of navel oranges from California or the New Satsuma oranges from Florida—whenever you enjoy any of these things, you are

reaping the benefit of the work done by a handful of explorers employed by the Department of Agriculture.

If you live in the Gulf Coast region, you probably are familiar with the rise of a new industry down there, the growing of tung oil trees. About twenty-five years ago tung oil revolutionized the manufacture of varnish, but the oil had to be—imported from China. Back in 1905 David Fairchild, plant explorer of the Department of Agriculture brought the first seeds of the tung trees to the United States from the Yangtze Valley of China. Our plant industry men discovered, after a good deal of experimentation, that the trees do well in the Gulf Coast region, and the new industry is today firmly established there.

Not every trip of a plant explorer, of course, is so productive. Every trip has its dangers and its adventures, but frequently the results are slight. Yet the introduction of a navel orange or a useful variety of soybeans or a hardy wheat atones for many unsuccessful trips.

In one way or another, I have said, every farmer in the United States is farming differently today because of the scientific discoveries resulting from state and federal appropriations. To be specific and as up-to-date as possible, suppose we run down the list of research achievements reported by one bureau of the Department of Agriculture for the past years. Before me is a summarized report for the Bureau of Plant Industry, and among their accomplishments I find these items.

" Established the superiority of five new hybrid lines of corn in Iowa tests; released, for the use of growers, two new lines of hybrid sweet corn that will be resistant to bacterial wilt; released, for the use of growers, a new wilt-resistant variety of tomato, known as the Fritchard ; introduced a new blackberry variety, the Brainerd, especially adapted for the West and South, and also introduced three unproved varieties of strawberry ; developed new root-stocks for Satsuma oranges, and found new disease—resistant stocks for California grape vineyards ; introduced a new sugar beet, U. S. No. 1, that is resistant to the costly curly top disease, and that also greatly outyields older varieties ; tested some promising new sugar-cane seedlings, crosses of American and New Guinea varieties ; reported distinct progress in breeding alfalfa that will be immune to bacterial wilt : developed a new variety of Egyptian cotton in Arizona.

As another part of its job, this bureau investigates the storing, handling and processing of foods. For the year under report the bureau scientists discovered, among other things, that putting apples in cold storage immediately after picking almost completely prevents soft scald ; that adding sulphur

dioxide to the saw-dust packing of grapes retards the development of mould; and that treating fruits with carbon-dioxide before shipment is as effective as pre-cooling in preventing spoilage."

That is a partial report of the research accomplishments of one bureau. It gives point to the statement that research can stabilize crop production and eliminate or reduce those hazards—of disease, of climate, even of soil—which make agricultural production uncertain. For it remains true that though drouth or disease or insect pests may raise the price of a crop by reducing the supply, such higher prices are cold comfort to the particular farmer whose cotton has been destroyed by the boll weevil or whose wheat has been hit by rust. I have, I think, a proper scientific respect for insects and diseases, but I question whether we ought to leave it up to them to determine the size of our crops and the level of our incomes. Nor can I forget that every year, according to Dr. L. O. Howard, the damage wrought by insects nullifies the labour of a million men.

If time and your patience permitted, it would be possible to cite instances to show how research has affected all our major farm crops and classes of live stock, how the patience, the skill and the informed imagination of scientists employed by the Department of Agriculture have altered the agricultural map of this country and modified the farm practices of every farmer in the land. Many farmers are not aware of this, for the results of research reach the individual farm by an intricate, devious path, but they get there just the same.

If you will agree with me on that, I suspect you are at the same moment questioning whether this research has proved to be an unmixed blessing. For science and invention you will say, have not only made it possible for us to produce enough to go around: they have made it possible for us to pile up towering surpluses, which in turn seem capable of bringing our whole economic system crashing down around our ears.

We cannot deny that, when scientists in the Department of Agriculture develop a variety of wheat that produces five bushels more per acre than the variety commonly grown, one result may be, and often is, too much wheat. When our modern knowledge of nutrition enables one bushel of corn to go as far as two bushels did in the pioneer days in feeding livestock, one result may be too much pork and lard.

Of late years the Department of Agriculture and the colleges have been aware of the problem. They have tried to meet it by helping the individual farmer to adjust his own production to changing market needs. They have hoped that advice and complete information on supply and demand would suffice.

Where they have been remiss, in my judgment, is in declining to face the fact that the individual farmer cannot adjust his production intelligently, unless he knows, with some degree of certainty, that his neighbours will do likewise. And it is to face that fact realistically that the new Farm Bill has been drafted. The essence of it is collective action, by all the producers, to accommodate their production to the market that actually exists.

Our expenditures for science, our efforts at increasing productive efficiency, have in no sense been unwise. Certainly no thoughtful person could approve the abandonment of scientific research, or the relegation of our machines to the ash-heap. To do that would be like abandoning the use of automobiles because we have automobile accidents. As a rule, the fault is not with the automobile, but with the driver.

It is not the fault of science that we have unused piles of wheat on Nebraska farms and tragic bread-lines in New York City at one and the same moment. Rather it is because we have refused to apply science to the development of social machinery, machinery that will regulate our economic system to the end that what we produce can be equitably divided.

I am not one to ask for less efficiency. I want more, and I know that we can get far more. But I want the efficiency to be controlled in such a way that it does more good than harm. I want to see the farmers of the South grow 300 pounds of cotton per acre instead of 150 pounds and the farmers of the North 50 bushels of corn per acre instead of 35 bushels. I want to see the average milk cow yield 400 pounds of butter fat per year instead of 200. And I see no reason why our hogs eventually should not produce 100 pounds of pork on the average from 6 bushels of corn, instead of from 9 bushels.

These things can all be done. The research now going on will make it possible, and will pave the way for countless new agricultural achievements as well.

Only the other day I learned that research now in progress indicates that crops grown in some regions of the nation have a higher nutritional value than do apparently similar crops grown in other areas. If further study bears this out, the consequences will certainly be far-reaching. We may have a new agricultural map a decade from now.

The research job, for from being done, is only well begun. We shall need new varieties of cereals and grasses to resist diseases better than those we now have. We shall have to keep cutting costs of production by increasing yields

per acre. Methods of cultivation, like methods of feeding and managing livestock, must be subject to continuing investigation if we are to keep abreast of the continually changing economic world about us.

When our chemists, not long ago, discovered an economical method by which begasse, a sugar-cane waste, could be made into high quality cellulose, suitable for rayon, we patted ourselves on the back for an achievement of considerable importance. But over in the Bureau of Chemistry and Soils is a small bottle of a brownish cellulose substance called lignin, which was derived from the corn plant after many years of experimentation. The chemist will tell you that lignin is one of the principal parts of woody plant tissues : that it can therefore be obtained in abundance ; and that it may yield a startling new collection of products. Already he has discovered in lignin such compounds as phenol and creosol. Lignin may yet rank, in its rich potentialities, in its influence on disposing of farm wastes, with our major chemical discoveries.

No, the job of scientific research in agriculture is not over, nor will it ever be. But today we have a new job, a new field for experimenting—that of social control. Research to increase productive efficiency, to widen markets, must continue. Eliminate the less important research activities, in deference to the need for economy ; get rid of the dead wood in our scientific organizations —but keep the men of science at the tasks which will always need doing. And add to the old job the one that has been begun so well, this new job of developing the machinery of social control.

Can we, do you suppose, become as efficient in our social experimenting as we have already proven ourselves in scientific experimenting ? If this can be done, we can go ahead into one triumph after another in the scientific world. If it is not done, I fear for the future of our civilization.

The Farm Bill is an effort in the direction of such social inventiveness. In some ways, it is perhaps as crude as the first automobile. But I believe it is profoundly right in purpose, for it attempts a reconciliation between science and social justice ; and I believe it can be made to work, if the rank and file of the people of the United States—the men who grow our food. the men who handle and distribute it, the men and women who consume it—the new machine will work if all these people are genuinely hungry to distribute the fruits of science in a just way.

For that is our great modern problem. Having conquered the fear of famine with the aid of science, having been brought into an age of abundance, we now have to learn how to live with abundance. Sometimes I think it

requires stronger characters, greater hearts and keener minds, to endure abundance than it takes to endure penury. Certainly it requires a new degree of tolerance among competing economic groups and a willingness to subordinate the will of the few to the welfare of the many.

Personally, I think the last twelve years have imprinted this lesson deeply on all of us. I think we are ready, now, to reach out towards a new order. I believe we are ready to attempt to plan our economic life in return for stability and security. If this is true, then we have reached a great moment in the history of mankind. We have determined to become the masters rather than the victims of destiny. We are daring to bring the economic interests of men under conscious human control.

We may make mistakes along the way ; we may have difficulty in mastering all the intricacies of an economic system that is full of puzzling contradictions ; but if we operate our new social machinery with the spirit of social justice in all our hearts, I believe that it will work.

LAND RECLAMATION IN ITALY—THE PONTINE MARSHES.

The policy of "Bonifica integrale" which is now entirely altering the aspect of certain parts of Italy, may be described as the execution of comprehensive schemes of land drainage and irrigation operations together with the construction of roads, aqueducts, rural buildings, farm workers' dwellings, etc. The general underlying principle is that land drainage and sanitation measures are inseparable from agricultural improvement and settlement. The ultimate object of the schemes is to improve rural conditions and to settle permanently on the land a larger number of workers and families, thus intensifying agriculture and checking the progressive urbanisation of the population.

One of the largest schemes is the drainage of the Pontine Marshes. It is less advanced than some of the other schemes, but it is completing a task which successively baffled the Caesars, the mediaeval Popes and Napoleon.

The Pontine marshes are approached from Rome along the Appian Way and are situated in a vast plain approximately rectangular in shape, which extends from the Lepini mountains to the Tyrrhenian sea and covers an area of 700 square kilometres. The luxuriant vegetation, which covered the marshes when the water was low, indicated the inherent richness and fertility of the underlying soil.

This area, the Pontine marshes, was once one of the richest and most

prosperous parts of Italy when, under the jurisdiction of the Volscians, canals had been constructed and dykes built to keep out the invading waters. The conquest of the Volscians by the Romans put an end to the prosperity of the region, and twenty-four centuries of wars and internecine strife have prevented any of the numerous enterprises for the reclamation of the Pontine marshes from being completed.

They were drained in 1889. The marshes were separated from the sea by a range of sandhills and covered an area of about 7½ square miles, made up as follows :—

		Acres.
Permanently submerged land, submerged about 2 feet	...	1,690
Land flooded in winter only ...	...	768
Marshlands, not flooded, but too wet for cultivation	...	2,008
Higher ground only saturated in winter ...	...	227
Total	...	4,693

For drainage purposes the marshes were divided into (*a*) an area from which the water could be drained by gravity, and (*b*) an area from which the water had to be pumped.

The Mediterranean being a tideless sea, drainage by gravity at low water through tidal sluices was not possible, and all water below sea level had to be pumped.

A system of open ditches and drains was dug, delivering into main channels; 80,000 lineal feet of channels were formed, with an average fall of 1 in 3,330.

The drains were designed to lower the standing water level in the ground to 2.62 feet below the surface, leaving 2.3 feet of water in the channels, the bottom of which averaged 2.95 feet below mean sea level.

In the ordinary way, 1,200 hours pumping per annum sufficed to keep the land drained.

In 1929, a society was formed under the name of the Society of the Bonifische Pontini, which once more started the work of reclamation. The Pontine marshes are formed from spring waters and rainwaters which, owing to the level configuration of the ground, cannot find an outlet and form stagnant pools. The first work of the Society was to repair the canals built by the Volscians. Besides the ordinary rainfall and water from springs, another source of trouble is the torrential water which descends from the mountains during the winter and early spring. To deal with this, the Society decided

to build, below Cori, an immense reservoir of 20 million cubic metres capacity, where the waters would be stored, and which would provide the whole countryside with hydro-electric power of about 1,000 horse power. The water could also be used for irrigation purposes.

A feature of the district is the 4 lakes on the littoral, which extends for about 40 kilometres by 2 kilometres. These lakes, although surrounded by malarial swamps, are the seat of a flourishing fishing industry. To do away with the danger of malaria it was decided to flood the whole area with sea water, thus killing all the marshland vegetation and preventing it from being a breeding ground for malarial mosquitoes.

In 1922, 2,500 hectares of unproductive lands were reclaimed and converted partly into grassland and partly into arable land. Cereals are grown, and leguminous plants, grapes and carnations are also cultivated. In 1921, 90 hectares of tomatoes were grown as an experiment which proved wholly successful, the tomatoes being canned on the spot in a small cannery built for the purpose.

In the lagoons near the coast an ingenious system of warping is being practised. A hydraulic dredger floats in the deeper water and pumps sludge on to the half-dry land alongside, where belts of reeds help to retain the sediment. Eventually an area of cultivable land is obtained, interspersed with lakes carrying fish.

Incidentally it has been proved that the idea that rice growing contributes to the spread of malaria is wrong. In the provinces of Italy where practically all the rice is grown, malaria is hardly known. The more rice growing increases, the more malaria decreases. Where the agricultural return is least (Sardinia, Basilicata), the mortality from malaria is greatest and vice versa. (Reprinted from the Monthly Letter No. 17, March 1933, of the Imperial Bureau of Soil Science, England.)—*Agriculture and Live Stock in India.*

Gleanings

Producing a new Bee.—Have you ever stopped to think that the fine large domestic animals—horses, cattle, hogs, chickens and so on—with which we are all familiar are essentially not Nature's work but man's? Like our fruits and vegetables, our domestic stock was developed comparatively recently from what we should call today, if we could see them, only scrubs and runts. Breeders have accomplished this by artificial selection—controlled mating. But it never has been possible to control the mating of the honeybee, hence bees

have remained bees until now. What the breeder of domestic animals has dreamed of is a better bee—one, for example, with a longer tongue so that it might obtain nectar now unobtainable from deep flowers; a stronger bee that could carry heavier loads of honey and fly farther for them; a bee that was more disease-resistant and gentle. These qualities would have great economic value, for our honey crop is about 80,000,000 pounds per year. A method doubtless destined to produce these qualities, the artificial insemination of the queens from selected drones by means of delicate instruments has at last been found, and bees are already being inseminated by a few advanced breeders. Credit for making this advance practical goes mainly to Dr. Lloyd R. Watson, Director of Research at Alfred University. The Watson technique is described minutely in Technical Bulletin 326 of the United States Department of Agriculture, by W. J. Nolan of the Bureau of Entomology. (*ScientificAmerican*).

Wheat crop in America.—Figures recently published by the United States of America indicate that the 1933 wheat crop will only be about 55 percent of the normal. The expected crop is 500,000,000 bushels which is less than the quantity usually required for domestic consumption. In view of the huge surplus stock of wheat held by the United States of America this fall in the production will help to relieve the situation. Three things happen to the annual wheat crop in the United States. From 600,000,000 to 700,000,000 bushels go into domestic consumption. Since 1923 this consumption has increased less rapidly than the population. The two other channels into which the supply goes are exports and carry-over. As the exports decline, the carry-over mounts. Records of the United States Department of Agriculture show that in the year ended June 30, 1923, we exported 205,000,000 bushels and had a carry-over of less than 100,000,000 bushels. In the year ended June 30, 1932, we exported 112,000,000 bushels and had a carry-over of 362,000,000 bushels—three times the normal. It might be supposed that these declining exports and mounting carry-overs implied a slump in world wheat consumption. As a matter of fact, the world consumption of wheat grew steadily in the last decade. In the 1930-31 season the total apparent disappearance of wheat outside Russia and China was 3,800,000,000 bushels, as compared with only 3,200,000,000 bushels in 1921-22. World wheat consumption in the deprosssion year 1930-31 exceeded that of the preceding year and about equalled that of the highly prosperous season 1928-29. It was not falling consumption that brought about our mounting wheat surplus. It was rising production here and abroad. (*Scientific American*).

Nitrogenous Manuring of Legumes.—The question of using nitrogenous

fertilisers on leguminous crops like peas, beans and lucerne, has been much discussed of late on the Continent. What has generally been considered the best practice in Great Britain and elsewhere is to restrict their use to a young crop, the growth of which needs accelerating; otherwise they are uneconomic. The opinion is, however, fairly widespread that fertilisers containing readily assimilable nitrogen are distinctly harmful to the nitrogen-fixing activities of the nodule bacteria; and it was this contention that induced H. Burgevin, at Versailles, to investigate the question (C. R. Acad. Sci., Paris, 199, 441-43, 1933, and C. R. Acad. d' Agric.de France, 19, No. 6, 1933). Soya beans were grown in naturally sterile soil contained in pots, one series being inoculated with a culture of B. radicicola specific to the soya bean, and the other left sterile. In addition to a basal dressing of phosphate, potash and chalk, inorganic nitrogen in the form of nitrates and ammoniacal salts was applied in dressings equivalent to 0, 45, 90, and 135 lbs. of nitrogen per acre (or to 0, 2, 4 and 6 cwt. per acre of sulphate of ammonia); and it was found that the plants in the sterile soil that had received nitrogen developed proportionately to the amount of nitrogen applied, although their leaves turned perceptibly yellow. In every case the inoculated plants did best, and not only did they not suffer from the presence of the added nitrogen, but also they utilised it to advantage, as well as the nitrogen fixed by the bacteria. Even the highest applications of added nitrogen did not injure the nitrogen-fixing power of the nodule bacteria; so that the use of small dressings of nitrogenous fertilisers for legumes, to assist their early growth, if necessary, appears fully justified. (*Nature Vol. XXXI, 1933 p. 660*).

"Boiling" an Egg with a Noise.—What kind of a noise annoys an oyster? A noisy noise annoys an oyster! Modern science has gone one better than the old conundrum by discovering that a noisy noise will also boil an egg! At least, Dr. E. W. Flosdorf and Dr. L. A. Chambers subjected a raw egg to a sharp sound for a few minutes, before a recent meeting of the American Association for the Advancement of Science, and apparently "softboiled" it without raising the temperature. The secret of the phenomenon seems to be that intense sound will bring about certain chemical reactions. The two noise-making doctors are able to coagulate proteins, convert ethyl acetate to acetic acid, and generate acetylene from vegetable oils by subjecting the substances to the proper sound of sufficient intensity. Attempting to explain the mechanics of their discovery, the scientists submit the hypothesis that the sound vibrations produce accelerated vibration in the molecules of the substance concerned, this stimulation producing a spontaneous chemical reaction much as heat frequently

does. Most of the sounds used in the experiments were shrill and loud, but some were quite musical. (*Scientific American*).

A new process of fertilizer manufacture.— Ammonium sulphate, ammonium phosphate, and other ammonia fertilizers were formerly made by running the appropriate acid into ammonia liquor. Since the reaction took place in a liquid and acid medium, the product was invariably damp and acid, and had to be dried further and neutralised before it could be used. The new Fauser process yields ammonium salts which do not require drying or neutralizing, but can be immediately applied in the field: the process can be used not only for making ammonium sulphate and ammonium phosphate but also compound fertilizers like ammonium sulpho-nitrate (Leuna Saltpetre) and ammonium sulpho-phosphate. By this process, sulphuric acid in the form of a very fine mist, which is produced in a special atomizer, is sprayed into an atmosphere of dry ammonia gas. The reaction thus takes place in an alkaline and gaseous medium and produces directly a neutral and dry salt. The sulphuric acid mist, produced from acid of 52° Be, is introduced into the top of a chamber, while an hydrous ammonia gas enters through apertures disposed on the bottom. The resulting salt falls on to the floor of the chamber, passes through a number of openings, and is taken up and transported by a screw-conveyor. Small amounts of ammonia that adhere to the salt are removed by an air-blast, and are, of course, recovered. Since the salt so obtained has a micro—crystalline structure (which entails setting to hard and compact masses on storage, re-crushing, and difficulty in sowing uniformly) a regulated quantity of water is added to it while still on the conveyor, and owing to the peculiar construction of the conveyor the micro-crystals are converted into small round spheres, which after drying in a rotary dryer do not harden or cohere during storage. The heat-balance of this process is so favourable that all heat losses are covered by the heat neutralization. If the production exceeds 50 tons a day, the heat loss per apparatus is reduced and a more dilute sulphuric acid can be used. (*Chemistry and Industry, Vol III, 1933, No 4, p. 74*).

Distribution of Manure in the Field.—It has always been recognized that unevenness of distribution of artificial manure may cause local starvation or even poisoning in the crop, and much attention has been paid to the construction of manure drills and distributors of various kinds. In practice, the manure distribution is usually followed by some cultivating implement, the function of which is to mix the fertilizer with the soil. Until recently, the degree of mixing attained by the various classes of implements was only a matter of conjecture, but an ingenious method has now been devised in

Germany to render the particles of manure in the soil directly visible, thus enabling depth distribution studies to be undertaken in soil samples carefully removed from the field. The fertilizer is treated with anthracene before sowing, and after distribution and cultivation the samples are examined in ultra-violet light. By this means it has been found that the newer rotary cultivation gives a more uniform distribution than either the surface working implements or the plough. The extent to which these differences of location of the fertilizer affect the crop has not yet been extensively investigated, although on general grounds, thorough incorporation would seem to be desirable, particularly with relatively insoluble manures. (*Nature Vol. CXXXI, 1933 p. 445*).

Middle-class Unemployment.—One of the most important subjects discussed at the Industries Conference was the question of middle class unemployment. It is understood that the most interesting and constructive scheme which was put before the Conference was that unfolded by Mr. G. S. Dutta, I. C. S., Director of Industries, Bengal, on behalf of the Hon'ble the Minister Nawab K. G. M. Faroqui, involving one lakh of rupees per year. The object of the scheme is to change the present academic mentality of young men and to give them an industrial mentality. It provides for intensive training under expert guidance in seven practical industries such as manufacture of brass and bell-metal articles, glazed pottery, soap, boots and shoes, woollen shawls, etc. Improved appliances have been specially devised by the Bengal Industries Department to make these industries attractive to middle class educated young men and to reduce the cost of manufacture so that they may compete on favourable terms with factory products. It is understood that the scheme provides for training not only in scientific and manipulative processes of manufacture, but also for giving a thorough business training in methods for the purchase of raw materials and disposal of finished products by organizing markets for them with the assistance of industrial surveyors specially employed for the purpose. The scheme as unfolded by Mr. Dutta evoked considerable interest among the representatives of other provinces and Indian States, many of whom are visiting Calcutta to study the scheme.—(*The Mysore Economic Journal*),

Current Research

Inheritance of flowering duration in rice.—(Oryza sativa). K. Ramiah. (*Ind. J. Agric Sci.* 3,377-410). From the examination of this character in the progenies of several crosses made at the Paddy Breeding Station, Coimbatore, it is found that the inheritance of this character may be either simple with a single factor difference, or complicated, explainable under the multiple factor hypothesis. There appears to be several genetic factors concerned in the inheritance of flowering duration in rice, and varieties should carry in them one or more of these factors. Varieties that have the same flowering duration may still differ in their factorial composition with regard to this character giving a transgressive variation in the F 2 s when crosses are made among them. Earliness is generally found to be dominant to lateness, although a case has been recorded where it was recessive to lateness. By growing a sufficient number of generations, even in the most complicated cases involving inheritance of flowering duration, it would appear possible to interpret the results on mendelian hypothesis and also determine the number of factors concerned. (*Author's abstract.*)

The diagnosis and treatment of sterility in the stallion and the bull.—(A resumé of literature) S. C. A. Datta (*Ind. Jour. Vety. Sc. and Anim. Hus.* 3, 155). Of the many problems of importance that the animal clinician has to grapple with, the determination of the cause of cessation of reproduction or reduced fertility in the living animal is one of the most perplexing. Variability in the fertility of the best known thorough-bred stallions and pedigree bulls or their absolute sterility has indicated a considerable loss to the breeding industry, but as the majority of the pioneers in this field have confined themselves to aspects of sterility in the female animal, the published literature on sterility in the male animal is in an unsatisfactory state and facts about the rôle of the male are less familiar. Increasing demands for scientifie veterinary knowledge for help against sterility are now being made and the problem is also increasing in its scope due to certain recent developments in endocrinology. For the reasons stated above the rôle of such factors of sterility as environment, diet, endocrine secretions, hereditary fertility factor, seminal pathology have been discussed and the available methods of diagnosis and treatment of such sterility enumerated. It will be realised that further research and enquiry are urgently required for elucidation of this problem and the author hopes that this resumé may lead to this end amongst workers in India (*Author's abstract*).

Effect of Storage on Vitamin A in Dried Foods.—(*Industrial and Engineering Chemistry*. Vol. 25, April 1933, pp. 465, 466). The recognition of the importance of vitamin A in human and animal nutrition has increased the commercial importance of some foods or feeds known to be good sources of vitamin A. Alfalfa meal, alfalfa leaf meal, yellow corn, and some other feeds are used by feeders and by manufacturers of commercial feeds, partly for the purpose of supplying vitamin A. Preference is given to certain human foods on account of their high content of vitamin A. The effect of storage on vitamin A thus becomes of industrial as well as of agricultural importance. Information regarding the effect of storage upon vitamin A in foods is limited and somewhat contradictory. There is a gradual loss during storage in the vitamin A content of alfalfa leaf meal, dried black-eyed peas, dried green sweet peppers, yellow corn, and powdered whole milk. Measured by the Sherman Munsell unit method, alfalfa leaf meal lost about 50 per cent of its vitamin A in 11 months, dried black-eyed peas 50 per cent in 9 months, dried green sweet peppers 80 per cent in 19 months, powdered whole milk 60 per cent in 9 months, and yellow corn 30 to 50 per cent in 6 months. The loss of vitamin A in dried samples stored in the laboratory should be taken into consideration in experimental work. It is possible that the loss would be less for goods stored in a cooler climate or in cold storage. The loss of vitamin A in stored feed may be a factor of considerable importance in connection with the feeding of animals or man. The amount of destruction of vitamin A varies both with the length of the storage period and the kind of material containing the vitamin. Grinding corn before storage does not seem to increase to any noticeable degree the loss of the vitamin A in yellow corn as compared with the whole grain.

A comparative study of cropped and virgin soils.—By Clarence Dorman (*Soil Science*, Vol. XXXVI 1933, p. 101). The chemical composition of cropped and the corresponding virgin soil of several different soil types was determined. With the exception of nitrogen content which, with one exception, was higher in the virgin soils, a comparison of analyses of cropped and virgin soils showed no consistent differences. In many instances, wide differences in the quantities of certain elements are noted within a given soil type. In the lighter soil types phosphorus has been decreased by cropping. In the heavier soil types phosphorus has been increased by cropping. Exchangeable hydrogen, aluminum, manganese, calcium, magnesium, sodium, potassium, ammonium, absorption capacity, and pH were determined. Very small differences were found in the exchangeable hydrogen of cropped and virgin soils. There has been no change in pH due to cropping. The content of the exchangeable bases calcium, magnesium, sodium, and potassium varies widely in

different soils. Five types showed an increase in base exchange capacity and total bases in the cropped soils, and two showed a decrease. The percentage of the total bases that are exchangeable increases as the soils become heavier. As the texture of the soil becomes finer the relative proportion of the total bases and exchangeable portions constituted by calcium decreases. With one exception the percentage of the total phosphorus readily available was greater in the virgin soils. In all types studied the percentage of exchangeable calcium readily avaiable was found to be greater in the cultivated soil. This indicates that calcium is held more firmly by the absorbing complex of the virgin soils. Pot experiments were conducted with these soils in the greenhouse. The virgin soils gave greater plant growth under all treatments than did the cropped soils with similar treatments. Virgin checks gave an average increase of 99 per cent plant growth over cropped checks for the two crops. Plant responses to phosphorus were in good agreement with laboratory determinations of readily available phosphorus. The cropped soils gave the greater response to nitrogen fertilization. Neither the cropped nor virgin soils responded to potassium fertilization. The difference in yield of the cropped and virgin soils was greater with the second crop than with the first. (*Author's summary and conclusion*).

The influence of a mulch on soil nitrates.—A. B. Baumont and G. Chapman Crooks (*Soil Science* Vol. 36, 1933, p. 121). Further evidence has been accumulated concerning conditions surrounding the accumulation of soil nitrates under a mulch of waste hay and straw applied .to the surface of the soil under apple trees. None of the mulch was incorporated in the soil by plowing or working in any manner. During the first 3 years of the experiment nitrates accumulated to a slight extent only. During the fourth year after the mulch was applied nitrates accumulated rather consistently, and often in large amounts. The hypothesis is advanced that nitrification occurs mainly in the lower, humified layer of the mulch in contact with the soil rather than in the soil proper, and, by leaching, the nitrates are carried into the soil. It appears that nitrates accumulate only after the carbon nitrogen ratio has been narrowed by the processes of decay acting on the organic matter of the mulch. (*Author's summary*).

Colouring of apples after gathering.—H. Goude (*Journal of the Ministry of Agriculture London1933*, Vol. 39, No. 10). Colour in dessert apples is considered by growers to improve the commereial value of the fruit. For many years at the Burlingham Horticultural Station a method has been practised of improving the colour of apples after they are picked by exposing them in trays

to sunlight and weather for a period of about 10 days. As the fruits receive any available sunshine and also night dews the process is called "Sun-dewing". If it is desired to colour the under-side of the fruit, they are turned in order to face up to the light the uncoloured part of the apple. The fruits react more quickly to the treatment if they are set out in trays immediately after picking. If they are stored it takes a longer period for the fruit to develop the desired colour. The method requires no expensive apparatus. Potato trays are lined with a layer of wood wool or clean moss to hold the moisture. The green fruits are then packed with eyes upward, on the trays which are then placed on the roof of a shed facing south, and are covered with fish netting to protect the fruits from birds. The fruits and trays are thorougly wetted with clean, soft water. It is necessary to maintain a moist atmosphere around the trays to prevent evaporation and shrivelling. Watering was found necessary at the Station every 3 days. At the end of the 10 days and nights the fruits were coloured and firm. If any frost occurs it is washed off the fruits with clean water before the sun's rays reach the trays. The "sun-dewed" fruits keep longer than those stored straight from the trees and the flesh quality is improved. Apples with a greasy skin do not respond to the process. The colour and skin texture of commercial varieties of pears have also been improved by "sun-dewing."

Review

'Sagbhaji Ki Kheti' (Cultivation of Vegetables). Written and published by Mr. N. D. Vyas L. Ag., *Imperial Agricultural Institute, Pusa*, Pusa; Pages 297, Price Rs. 2.

The publication is a useful addition to the scanty stock of literature on agricultural subjects in Hindi. It should prove very advantageous to students of agricultural schools and colleges, to those already engaged in vegetable gardening either for 'kitchen' or for market purposes and to officers of the Agricultural Departments engaged on propaganda work. The auther has taken great pains in collecting the information contained fn the book, and has lucidly explained various matters concerning vegetable gardening. Those who have not had agricultural education will find in the book some new information which, if acted upon, should help considerably in successful growing of vegetables and prevent the losses which often occur on account of dismal failure of crops, simply because, through ignorance or neglect, important details of

cultivation are not carried out. Every chapter of the book must be read carefully and intelligently for details. Amateur gardeners before starting gardens should, however, seek for the help of practical men who may be available locally and with their co-operation try to work up to the information contained in the book. The author has mentioned in the chapter on manures that the doses required for different vegetables as given by him are for rich garden lands. This should be noted carefully because these doses on poorer soils will not give quite effective and encouraging results. The chapter on insect pests and fungoid diseases places before ordinary *kachis* and *malis* new information which, if intelligently applied, should prove advantageous to them. Indian vegetable growers are at present indifferent to remedial or preventive measures against crop pests and therefore their crops are sometimes seriously affected and their profits are thus considerably reduced. The simple remedies suggested by the author in this chapter, if adopted by gardeners, should go a great way in changing the aspect of Indian gardening.

The subject matter of the work has been treated under suitable headings. The appendices towards the end are useful for different parts of India.

Chapter IX contains useful suggestions intended to show *kachis* and *malis* (vegetable growers) how to earn better returns for their labour by selling vegetables advantageously.

The langugage is simple and easily understandable by ordinary Hindi-knowing people except for some words here and there unknown to those outside the residential province of the author. It is hoped that future additions may show improvement in this direction by having a vocabulary particularly of technical terms.

Mr. Vyas is a product of the Nagpur Agricultural College and we therefore are particularly pleased to congratulate him on his efforts in compiling and publishing the book, which we strongly recommend to those interested in gardening.

Crop Forecasts

RICE.

First Rice forecast : All India 1933-34.—This forecast is based on reports furnished by the undermentioned provinces and States which comprise about 96 per cent of the total rice area in India. The reports deal with autumn and winter rice. Information regarding the summer crop will be included in

the Final General Memorandum which will, as usual, issue in February next.

The total area sown is reported to be 74,994,000 acres, as against 75,132,900 acres, the corresponding estimate (revised) of last year, or a decrease of 138,000 acres only.

Central Provinces and Berar (7.6 per cent).—The area sown is estimated at 6,473,000 acres (841,000 acres being in eight Feudatory states), as compared with 6,939,000 acres reported at this time last year. The monsoon was fully established in the third week of June and gave moderate to heavy rain everywhere. The rainfall in the first half of July, though light, was generally sufficient except in Hoshangabad, Nimar, Betul and parts of Berar where it was deficient. In the second half of the month good and beneficial rain fell all over the provinces with an opportune break in the third week. The monsoon continued vigorously till about the middle of August with heavy and persistent rain everywhere except in the north where it was moderate. Thereafter a welcome break set in and lasted for about ten days. Light to moderate rain fell in the beginning of September but the rainfall was heavy throughout the province in the second and third weeks of the month. Since then, a break has set in. Sowings were made under favourable conditions and germination was successful everywhere, though a little re-sowing was required in parts of Betul and Raipur districts. The condition of the crop is at present reported to be good and prospects are bright.

Rice Crop in Foreign Countries.—From information specially obtained, it appears that the official estimates of the first rice crop of Formosa for 1933 place the area and yield at 708,000 acres and 19,548,000 bushels (or 553,000 tons), showing an increase of 1 per cent in area but a decrease of about 7 per cent in yield as compared with the corresponding estimates of 1932. The production of the rice crop of Japan for 1933 is estimated at 65,608,000 koku (or 9,202,000 tons), which is 8.8 per cent more than the actual crop of 1932. The area planted in 35 provinces of the Inner Circles of Siam at the end of July 1933 amounted to 7,385,000 rai (or 2,954,000 acres), as against 6,257,000 rai (or 2,503,000 acres) at the same time last year. The condition of the crop is reported to be generally good.

From the latest available bulletin published by the International Institute of Agriculture, Rome, it appears that the production of the 1933 crop of the United States of America is estimated at 1,069,000 tons, showing an increase of 35 per cent, as compared with the 1932 crop. In Italy, the area sown for 1933-34

is 311,000 acres, as against 335,000 acres in 1932-33. The crop is in good growing condition. In Spain, the area and yield of rice are estimated at 116,000 acres and 290,000 tons, showing a decrease of 5 and 7 per cent respectively as compared with 1932.

SUGAR CANE.

Second Sugarcane Forecaste : All India 1933-34.—This forecast is based on reports received from provinces and States which contain, on an average, a little over 96 per cent of the total area under sugarcane in India.

The area, so far reported, this year comes to 3,349,000 acres, as against 2,998,000 acres reported at this time last year, or an increase of 12 per cent.

Central Provinces and Berar (0.8 per cent).—The area is estimated at 29,000 acres, as against 26,000 acres, the corresponding estimate of last year. The increase is attributed partly to favourable conditions at sowing time and partly to better prices obtained for the crop. The crop has not been affected by any adverse factor except that the recent heavy showers in September have slightly impaired the expectations of a full crop in Chhindwara and Nagpur districts. For the province as a whole, the yield is estimated at 114 per cent of the normal.

Sugar in foreign countries.—From the latest information received from the Sugar Technologist to the Imperial Council of Agriculture Research, India, Cawnpore, it appears that the world's production of sugar, both cane and beet, in 1932-33 is estimated by Messrs. Willet and Grey at 24,230,000 tons, showing a decrease of 2,054,000 tons (1,340,000 tons in the case of cane sugar and 714,000 tons in the case of beet sugar), as compared with the preceeding year. (*The Indian Trade Journal*).

College News

Mr. F. J. Plymen, C. I. E. who was for a very long time Director of the Central Province Department of Agriculture has proceeded on leave prior to retirement. Mr. Plymen was one of the pioneers of agricultural reform in India and has contributed not a little to the building up of the Department of Agriculture in our own province. During the early years of his service in these provinces Mr. Plymen was very intimately connected with the teaching

in this College. He was a very successful professor and his fluency of speech and cheerful disposition made him very popular amongst the students. He kept up his interest in the students and the college till the very close of his service here has always graced our college functions with his presence. Mr. Plymen was a very popular figure both in official and non-official circles and the eve of his departure was marked by a round of farewell parties. The members of the Department of Agriculture gave an 'At Home' in his honour on the 13th of October at the Agricultural Research Institute grounds. We wish Mr. Plymen a long life to enjoy his well earned rest.

* * * *

It is a matter of gratification to us that our erstwhile principal, Mr. John H. Ritchie, has been appointed as the Director of Agriculture to succeed Mr. Plymen. We offer our most hearty congratulations to him. Mr. Ritchie's tenure of office as Principal of the College has been a short one, nevertheless he has left his mark behind him. He has shown considerable interest in all matters concerning the college and the status and prospects of the agricultural graduates. In his new capacity as the head of the Department he can render invaluable assistance to us in realising our ambitions and we have no doubt that he will continue to extend the same sympathetic feeling towards us. We wish him all success.

* * * *

The students and staff of the College entertained Mr. Ritchie at a small *Pansupari* party in the College Hall. The general secretary spoke a few words on behalf of the students and Mr. B. R. Phatak on behalf of the staff. Mr. Ritchie in his reply assured the students that he would endeavour to do everything in his power to further their interests.

* * * *

We offer our hearty welcome to Mr. and Mrs. McDougall who have just returned to India after a short leave in England. We hope the holiday has given Mr. McDougall the rest that he greatly needed after a strenous period of duty.

* * * *

At a meeting of the students and staff of the College held on the 14th October it was decided to forego the social gathering this year in favour of rendering monetary assistance to the distressed people in the flood-stricken areas of this province. It was unanimously decided to hand over the whole collection for the social gathering to the Flood Relief Fund. A committee was formed to help the provincial organisation in collecting donations and old clothes for distribution amongst the helpless people.

* * * *

We offer our hearty congratulations to Mr. G. S. Gurjar L. Ag. an old boy of our college who has been appointed as Marketing Officer in charge of the *Verum* pooling operations.

* * * *

We are glad that some more of our new graduates have been able to secure appointments. Messrs. L. P. Khare, J. P. Tiwari and M. Akram have been taken on the *Verum* marketing scheme. Mr. J. G. Bhalerao has been appointed as an agricultural Assistant in the Southern Circle and Mr. S. A. Rahman has become District Agricultural Officer Warangal, in the Hyderabad State.

* * * *

Once again we had a refresher course for Agricultural Assistants. Twenty-two of them came from all parts of the province and all of them were old boys of the college. It was a pleasure for us to meet so many of our old friends who left college a long time ago. They also seem to have enjoyed the repetition of the old experience of listening to lectures and demonstrations.

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Editorial Notes

AN ECONOMIC SURVEY OF INDIA.

It was early in November that the Government of India announced their intention to carry out a comprehensive economic survey of India under the guidance of two British economic and statistical experts assisted by a number of Indian Economists of repute. The British experts invited for this purpose are Mr. Denins H. Robertson, University Lecturer in Economics at Cambridge, and Professor Bowley of the London University who is one of the most eminent statisticians in Europe. The two British experts have already arrived in India and have been joined by their Indian collaborators and the preliminary spade work has already been started. Speaking to a body of Calcutta business men at the Royal Exchange Sir George Schuster, the Finance Member of the Government of India, outlined the main objectives of the enquiry as follows :—

" Firstly I think it is necessary for us to stand back and attempt to make a complete and thorough diagnosis of the present economic position. In the second place the diagnosis having been made it is important that records should be kept up so that the Government and representatives of the people in the legislature or elsewhere may be able, if I may express it figuratively, to keep their figure on the economic pulse of the nation. In the third

place it is of growing importance that the people of India themselves should study and understand their economic position in a scientific way. The last objective is clearly connected with the idea of an economic census."

Thus the work of the enquiry as at present visualised comes under three main heads :—

(1) A preliminary survey based on such data as are already available or can be collected within a reasonably short period for the purpose of giving a picture of the present economic condition in India, particularly the developments of the past 10 or 20 years and the tendencies which may be expected in the future ; (2) a survey of India's existing statistical organisation and the preparation of a plan laying down the lines for keeping and interpreting statistical records in future and (3) a thorough and complete economic census on the lines of the census of production in the United Kingdom or in the United States of America.

The enquiry thus covers a very extensive field and will of necessity take a long time before it is completed. The present period of financial stringency is hardly a suitable opportunity for for embarking upon such an ambitious scheme. The Government hopes to enlist the cooperation of various bodies throughout the country such as the Universities and to get a great deal of the work done on a voluntary basis. An enquiry of this kind conducted on scientific lines and under expert direction would have an enormous educative value to India. It gives an opportunity for a large number of Indians to engage themselves in a practical task of supreme importance to the country. Further the information thus accumulated will be of great value for the guidance of Government policies and for the education of the public.

The world economic depression and the various attempts

made by different countries to fight it individually and collectively, have made it clear that international trade can no longer run in the old channels. With the growing spirit of economic nationalism and the desire of all countries to make themselves self-sufficient it is becoming impossible for any country to exploit to the full its advantages for specialisation in any particular direction. International trade, in the furture, is apparently to be on the basis of agreements and production has to be planned and controlled. Before making any such arrangements the Government and the public should be in possession of accurate data regarding economic conditions in the country, the tendencies of the past and the prospects of the future. Thus the proposed economic survey of India has not come any too soon and we are looking forward eagerly to hear more about the labours of the committee.

THE INTERNATIONAL WHEAT AGREEMENT, 1933.

A conference of the principal wheat exporting and importing countries of the world was held in London during the last week of August 1933 to consider the measures which might be taken to concert to adjust the supply of wheat to effective world demand and eliminate the abnormal surpluses which have been depressing the wheat market and to bring about a rise and stabilization of prices at a level remunerative to the farmers and fair to the consumers of bread stuffs. Representatives of the Governments of Argentina, Australia, Canada, the United States of America and most of the countries of Europe, including the Soviet, took part in the conference and the result of their discussions took the shape of the International Wheat Agreement. The Agreement falls under two parts.

(1) The first embraces certain undertakings by the principal

what exporting countries such as Argentina, Australia, United States of America, Canada, Blugaria, Hungary Roumania, Yugoslavia and the Soviet Republics, designed to limit the total exports and to reduce the acreage under wheat during the two crop years 1933-34 and 1934-35. The Governments of Argentina Australia and the United States of America have agreed that the exports of wheat from their several countries during 1933-34 shall be adjusted taking into consideration the exports of other countries and world demand for wheat, and they have further agreed to limit their export of wheat during 1934-35 to maximum figures, 15 per cent less, in the case of each country, than the average outturn on the average acreage sown during the period 1931-33 inclusive, after deducting normal domestic requirements. The Governments of Bulgaria, Hungary, Roumania and Yugoslavia have agreed that their combined exports of wheat during 1933-34 and 1934-35 will not exceed a total of 50 million bushels except that during 1933-34 the aggregate may be increased to a maximum of 54 million bushels if the Danubian countries find it necessary for the movement of the surplus of the 1933 crop. The Government of the Soviet Republic have not given any undertaking in regard to the production of wheat but they have agreed to limit their exports.

(2) The seccond part constitutes an undertaking by importing countries to prevent any action by the latter that would have the effect of counteracting the restrictions imposed by exporting countries and to bring about a reduction in tariffs and other barriers after a certain rise in wheat prices has occurred. The principal wheat importing countries have agreed not to encourage any extension of the area sown to wheat and to adopt every possible measure to increase the consumption of wheat. They have also agreed to a lowering of customs tariffs when the international price of wheat reaches and maintains for a specific period an average price to be fixed.

The Agreement as a whole may be summed up as an attempt to bring about a better adjustment between the supply of wheat and the effective world demand for it. The conference also decided to set up a wheat Advisory Committee consisting of representatives of the countries that were parties to the Agreement to watch over the working of the agreement and to review the general situation in relation to the various undertakings and to discuss any points that may arise in giving effect to them.

THE LEGISLATURE AND THE CULTIVATORS.

Rural affairs were well to the front in the January Session to the Central Provinces Legislative Council when several official and non-official bills and Resolutions affecting the cultivators were discussed. Amongst the Government bills, the Central Provinces Debt Conciliation Amendment Bill was intended to increase the strength of the Debt Conciliation Board, from five to nine, the Cattle Diseases bill was to make compulsory vaccination against rinderpest of all imported cattle, and the Irrigation Act Amendment Bill was intended to simplify the system of assessing irrigation revenue.

Perhaps the most important of the measures introduced during the session were the Usurious Loan Amendment Bill and money Lenders Bill both of which are intended to supplement the Central Provinces Debt Conciliation Act of 1933. The Usurious Loans Bill aims at removing certain difficulties which were experienced in the working of the Usurious Loans Act of 1918 and the Amendment Act thereof of 1926, so as to make the Act a more effective instrument for the relief of the debtors who as a class are unable to deal with the money lending class on equal terms. Although the bill does not give an absolute definition of excessive interest it provides for a presumption being

raised when the stipulated rates exceed certain limits felt to be reasonable for certain kinds of loans. The money Lenders Bill which is framed on the lines of the Punjab Regulation of Accounts Act of 1930 is intended to control the transactions of money lending in order to protect ignorant debtors against fraud and extortion. The Bill embodies, in addition, the principle of *Damdupat* with a view to discourage creditors from postponing the enforcement of their claims unconscionably. It also gives the courts extended powers to fix instalments for execution of decrees.

SOME NEW SCHEMES FOR RESEARCH IN AGRICULTURE IN C. P. & BERAR.

The Department of Agriculture, C. P. is looking forward to a large extension of its activities in the near future. Several research schemes have been put up before the Indian Central Cotton Committee and the Imperial Council of Agricultural Research and it is expected that a number of them will come through sucesfully. One of these Research Schemes put up before the Indian Central Cotton Committee aims at increasing the area under long staple cotton in this province. It has been experimentally proved that several taluks in and around Berar now growing short stapled cotton are suited for the growth of long staple. But popularising improved varities in these taluks will involve a considerable amount of propaganda. The Government has proposed that the Indian Central Cotton Committee should subsidise the Agricultural Department in this venture for a period of three years at a total cost of Rs. 86,000. Increasing the area under long staple cotton in our province will have considerable economic consequences, at any rate, it will reduce our dependance on the whims of our Japanese buyers. Another scheme put up before the Imperial Council af Agricultural Research has for its object the improvement in the conditions of Orange pro-

duction and marketing in this province. The Nagpur *Sangtara* is one of the most delicious fruits of its kind in the world. But the conditions under which it is produced and distributed leave considerable scope for improvement. Research in these directions will undoubtedly bring substantial benefits to the orange growers of this province. The other schemes cover a wide field such as improvement of oil seeds, potato storage, diseases of *pan*, investigations into pests of cotton and utilisation of sann-hemp. We hope that all these schemes will be sanctioned and will in time bear rich fruits for the agriculturists of this province.

RECONSTRUCTING RURAL BENGAL.

Sir Daniel Hamilton of Gosaba fame has come forward with a scheme for reconstructing Rural Bangal and for solving the problem of unemployment amongst the educated middle class people. His aim is to organise the villages into cooperative societies of reliable men and to displace the *Mahajan*. "......the serpent being dead, the *raiyat*, if not lazy can gather another Rs. 15 worth of oranges of each acre of his holding or ·46 crores from the 31 million acres of rural Bengal plus a good deal more by filling up his fifty or 75 per cent of spare time with other village industries and from improved agriculture." To take up the work of organizing the 50 millons of people of Bengal, another 6000 good first-class-men are required, who would live the life of the *raiyat*. The first step therefore is to train these 6000 men. Sir Daniel's scheme was discussed by the Calcutta University and the leading public men of Bengal and an influential working committee has been formed.

Institutes for training the workmen will soon be started at Gosaba and Mayurbhunj estates of Sir Daniel Hamilton and at Birnagar, (Nadia) the estate of Rai Bahadur N. N. Banerjee.

The scheme provides for one year's all round practical training in farming and in some small industries to be imparted by an efficient staff, both stipendary and honorary, with a view to infuse a spirit of self-help and cooperation amongst the students. The help of the Departments of agriculture, Industries Education, Cooperation Public Instruction and Public Health would be secured for the progress of the work and the institutes would be affiliated to the Calcutta University. The Institutes have large areas of land which will be utilised in growing different crops and fruits and flowers and students will freely assist in this work. Practical training will be given in farming dairying fruit and vegetable growing, weaving, spinning and in one of the small industries like dyeing, carpentry, tailoring, soap making, umbrella making, bee keeping and Poultry keeping. Students will be required to pay a tuition fee of Rs. 5 per month and a similar amount for messing expenses. On completing his training each candidate will be regarded as a Co-operative Colonist and he will be given 20 bighas of land, a hut and a tank, provided he can subscribe Rs. 200 to the initial capital required.

Original Articles

THE AVAILABILITY OF SOLUBLE PHOSPHATIC FERTILISERS IN TYPICAL RICE AND COTTON SOILS OF THE CENTRAL PROVINCES.*

BY D. V. BAL

AND

R. N. MISRA

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I. Introduction.—Various field experiments carried out in the past at the Raipur Experimental station (1930) show that phosphoric acid + nitrogen exerts a greater influence than nitrogen alone on the yield of paddy and that a combination of green manure with 3 cwt. superphosphate per acre gives the highest outturn and largest net profit. It was also shown by the authors in a previous paper (1932) that in the case of heavy soils with a basal dressing of green manure, sulphur gives increased outturn, but an annual application of super either individually or in combination with sulphur gives decidedly better results.

An examination of the results of the manurial experiments carried out at the Agricultural College Farm, Nagpur (1921) continuously for over 16 years on black cotton soil growing cotton every year shows, however, that cotton crop does not show any appreciable response to annual applications of phosphatic fertilisers although definite response to annual applications of nitrogenous fertilisers is visible.

An exhaustive review of literature dealing with the question of availability of soil phosphates, has been given, by Marais (1922), Russell (1932) and others, and therefore it is unnecessary to enter into those details here. Various authors have mentioned that utilisation by crop plants of soluble phosphatic fertilisers added to the soil may depend on the following important factors operating either individually or collectively :—

(1) Varying ability of plants to assimilate phosphorus.

* Paper read before the Agricultural Section of the Indian Science Congress held at Bombay, January 1934.

(2) Effect of soil on the availability of phosphates as influenced by its mechanical composition, organic matter content and its reaction.

The object of the experiments described in this paper is, therefore, to ascertain the period for which soluble phosphates remain in a water soluble or citric acid soluble state after they are incorporated with different soils.

II. Experimental.--Two soils were selected for the purpose of these experiments as detailed below :—

(1) Black cotton soil, a heavy soil found extensively in Berar and in some districts of the Central Provinces.

(2) *Sehar* soil, a well known light soil of the Central Provinces principally found in the district of Balaghat where it is conisdered to be a valuable rice soil.

Mechanical composition, calcium carbonate content, water holding capacity, and exchangeable calcium content of the two soils referred to above are given in table I.

Soil passed through a 2. m. m. sieve was employed in these experiments. Required quantities of black cotton soil were mixed with solutions containing known quantities of various soluble phosphates, and the total moisture content was kept equal to ½ the water holding capacity of the soil. The soil was then filled in glass jars which were covered with tin lids and kept in an incubator at the ordinary air temperature.

In the case of the *sehar* soil, quantities required to be employed for each determination were seperately taken in small beakers and treated with appropriate amounts of soluble phosphates and the whole soil was kept submerged under water according to the common practice followed in the rice fields, and the beakers were then kept in the incubator.

In all cases amount of soluble phosphates added to the soil was equal to 54.75mg. of P_2O_5 per 100 grams of soil, and the amount of nitrogen where added was always equal to 60 mg. nitrogen per 100 grams of soil.

In the first instance a series of experiments was conducted in which nicifos grade II (I.C.I.) was added to the two soils and the moisture content was brought up to the desired extent, and the amounts of water soluble phosphoric acid in the soils were determined at various intervals

during a period of 168 hours. For the determination of water soluble phosphoric acid a requisite quantity of soil was shaken with water and filtered. In the filtrate phosphoric acid was determined by the ammonium molybdate method as adopted by A.O.A.C. Results obtained from this series of experiments are recorded in table II.

It will be observed from these results that in the case of the black cotton soil as much as 95% of the added water soluble phosphate was converted into a water insoluble form almost immediately after the addition of the salt to the moist soil; and that the entire quantity of water soulble phosphate was converted into a water insoluble form after a period of 50 hours.

In the case of *Sehar* soil however only 75% of the added soluble phosphate was converted into water insoluble form immediately after it was incorporated with the soil, and that after a period of 70 hours about 3% of the added phosphate was still found to be in a water soluble condition.

It is well known that although a large portion of the soluble phosphate added to the soil is converted into water insoluble condition yet a portion of it which is soluble in a weak solution of carbonic or citric acid would be available to the growing plants.

A fresh series of experiments was therefore started in which the two soils with requisite amounts of water and phosphates were incubated for a period of 8 weeks and the determinations of water soluble and citric acid soluble phosphates in the soil were carried out at intervals of 2 weeks. The results obtained are given in tables III and IV. These figures corroborate the results given in tables II and discussed already in so far as they relate to the immediate conversion of a part of the water soluble phosphoric acid added to the soil into a water insoluble form. They further show that in the case of the *Sehar* soil about 50% or more of the added phosphoric acid remains in a citric acid soluble form even after a period of 8 weeks, whereas in the case of the black cotton soil the percentage of citric acid soluble phosphoric acid after the same period is about 30 to 40. In the case of *Sehar* soil all treatments gave nearly the same percentage of citric acid soluble P_2O_5 after a period of 8 weeks, green manure + super being somewhat better. In the case of black soil however treatment with green manure + super gave nearly 10% less citric acid soluble P_2O_5 after a period of 8 weeks than that obtained in the other treatments. In this connection it is interesting to

note that although *Sehar* soil is deficient in calcium carbonate and exchangeable calcium, soluble phosphates added to the soil were not converted into difficultly soluble phosphates of iron and aluminium.

From the results given above it appears therefore that from the point of phosphate nutrition of the crop, green manure + super would give better results in the case of the rice crop in *Sehar* soil, whereas for crops grown on the black soil which is not kept submerged under water, treatment with green manure + super would be less effective than the other two treatments. It also appears from these results that under field conditions in the case of *Sehar* soil which is deficient in $CaCO_3$ and exchangeable calcium production of CO_2 as a result of the decomposition of added organic matter, would bring into solution the phosphoric acid rendered water insoluble by the soil bases, and would thus help to maintain the citric acid soluble P_2O_5 content of the soil at a higher level than that in the case of black soil which is rich in $CaCO_3$ and exchangeable calcium.

III. Summary.

(1) Experiments to ascertain the changes which soluble phosphates undergo, and the period for which they remain in a water soluble and citric acid soluble condition, after they are added to moist soils have been described.

(2) It was found that in the case of black cotton soil, the entire quantity of the added water soluble phosphoric acid was converted into a water insoluble form after a period of 50 hours, whereas in the case of *Sehar* soil after a period of 70 hours about 3% of the added soluble phosphoric acid was still found to be in a water soluble state.

(3) In the case of *Sehar* soil, even after a period of 8 weeks about 50% or more of the added phosphoric acid remained in a citric acid soluble form, whereas in the case of the black cotton soil the percentage of citric acid soluble phosphoric acid after the same period was found to be about 30 to 40.

(4) From the results it appears that under field conditions in the case of *Sehar* soil which is deficient in calcium carbonate and exchangeable calcium a higher percentage of phosphoric acid is maintained in an available form to the rice crop than that which is available to the cotton crop grown on black cotton soil rich in calcium.

References.—Bal and Misra. (1932) *Agric. and Livestock.* *2.* 404—416.

Marais. (1922) *Soil Sci.* *13.* 355—409.

Nagpur. (1921) Annual Rept. Agric. College Farm.

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Russell. (1932) Soil Conditions and Plant growth. Longmans Green & Co., London.

Table I. showing the mechanical composition, Ca CO 3 content etc. of *Sehar* and Black Cotton soil.

Description of soil	Percentages in air dry soil.								Exchangeable calcium. Milligram equivalents per 100 grams air dry soil.
	Coarse sand.	Fine sand.	Silt.	Fine silt.	Clay.	Moisture.	Ca CO 3	Water holding capacity.	
1. *Shear* (Soil.)	8.44	25.26	23.20	19.58	18.13	2.33	0.42	40.0	10.045
2. Black Cotton Soil.	6.04	4.23	10.79	21.82	45.62	6.37	2.33	60.0	46.875

Table II. showing the effect of time on the variations in the amount of water soluble phosphoric acid after its addition to moist soils. (Amount of water soluble P_2O_5 added initially=54.75 mgms. per 100 grams of soil.)

Time in hours.	Black Cotton Soil.			*sehar* Soil.		
	Actual Amount of water-soluble P2 O5 found, expressed as mgms. per 100 grams of soil.	p. c. of the added P2 O5 converted into water-insoluble form.	p. c. of water soluble P205 left in the soil.	Actual amount of water soluble P205 found, expressed as mgms. per 100 grams of soil.	p. c. of the added P205 converted into water insoluble form.	p. c. of water soluble P205 left in the soil.
1	3.41	93.79	6.21	13.9	74.60	25.40
2	3.10	94.34	5.66	13.45	75.35	24.65
3	2.80	94.89	5.11	13.22	75.89	24.11
4	2.72	95.07	4.93	12.17	77.70	22.30
6	2.40	95.62	4.38	10.55	80.73	19.27
8	2.32	95.80	4.20	9.35	82.92	17.08
12	2.00	96.35	3.65	7.59	86.12	13.88
16	1.91	96.63	3.47	6.68	87.76	12.24
20	1.40	97.44	2.56	6.00	89.04	10.96
24	1.19	97.81	2.19	5.25	90.41	9.59
36	0.70	98.72	1.28	4.30	92.14	7.86
48	0.195	99.63	0.37	3.65	93.33	6.67
52	nil	100.00	nil	3.29	93.97	6.03
60	nil	100.00	nil	2.70	95.07	4.93
72	nil	100.00	nil	1.95	96.35	3.65
168	nil	100.00	nil	traces	100.00	traces

Table III.—showing the amounts of water soluble and citric acid soluble posphoric acid in *Sehar* soil; (soil kept submerged under water.)

Note :—(No trace of water soluble phosphoric acid was found in any of the treatments at the periodic intervals mentioned below.)

Treatment.	Total P2O5 added per 100 grams of soil in milligrams	After 2 weeks.		After 4 weeks.		After 6 weeks.		After 8 weeks.		Total P2O5 found after a period of 8 weeks, expressed as milligrams per 100 gram soil.
		Citric acid soluble P 2 O 5 in milligrams per 100 gram soil.	p. c. citric acid soluble P 2 O 5 remaining in the soil.	Citric acid soluble P 2 O 5 in milligrams per 100 gram soil.	p. c. citric acid soluble P 2 O 5 remaining in the soil.	Citric acid soluble P 2 O 5 in milligrams per 100 gram soil.	p. c. citric acid soluble P 2 O 5 remaining in the soil.	Citric acid soluble P 2 O 5 in milligrams per 100 gram soil.	p. c. citric acid soluble P 2 O 5 remaining in the soil.	
Soil alone. ...	nil	2.15	...	2.55	...	2.94	...	3.22	...	36.52
Soil alone- ...	nil	1.88	...	2.42	...	2.82	...	3.22	...	36.52
Soil + Nicifos. ...	54.75	28.62	48.63	31.18	52.47	30.50	50.50	31.31	51.36	89.85
Soil + Nicifos, ...	54.75	28.48	48.45	31.18	52.47	30.37	50.26	31.17	51.10	89.60
Soil + $(NH_4)_2$ So_4 + super. ...	54.75	28.35	48.18	30.58	51.37	29.83	49.27	30.37	49.63	88.58
Soil. + $(NH_4)_2$ So_4 + super. ...	54.75	28.22	47.93	30.57	51.37	30.10	49.76	30.50	49.90	88.76
Soil + green manure + super, ...	59.75	33.20	52.26	35.19	54.77	35.90	55.31	36.64	55.96	93.67
Soil + green manure + super. ...	59.75	33.33	52.47	34.83	54.60	35.77	55.10	36.50	55.72	93.67

Table IV.—Showing the amounts of water soluable and citric acid soluble phosphoric acid in Black Cotton Soil ; (moisture added $= \frac{1}{2}$ water holding capacity).

Note :— (No trace of water soluble phosphoric acid was found in any of the treatments at the periodic intervals mentioned below).

Treatment	Total P2O5 added per 100 gram of soil in milligrams	After 2 weeks.		After 4 weeks.		After 6 weeks		After 8 weeks.		Total P2O5 found after a period of 8 weeks, expressed as milligrams per 100 gram soil
		Ctric acid soluble P 2 O 4 in milligrams per 100 gram soil	p. c. citric acid soluble P 2 O 5 remaining in the soil.	Citric acid soluble P 2 O 5 in milligrams per 100 gram soil	p. c. citric acid soluble P 2 O 5 remaining in the soil	Citric acid soluble P 2 O 5 in milligrams per 100 gram soil	p. c. citric acid soluble P 2 O 5 remaining in the soil	Citric acid soluble P 2 O 5 in milligrams per 100 gram soil	p. c. citric acid soluble P 2 O 5 remaining in the soil	
Soil alone ...	Nil	3.89	...	3.63	...	3.76	...	3.76	...	73.46
Soil alone.. ...	Nil	3.76	...	3.89	...	3.76	...	3.63	...	73.04
Soil + Nicifos ...	54.75	26.34	41.16	27.95	44.22	27.82	43.98	25.93	40.66	127.60
Soil + Nicifos ...	54.75	26.60	41.63	27.95	44.22	27.95	44.22	25.93	40.66	127.88
Soil + (NH 4) 2 SO 4 + super ...	54.75	24.19	37.23	26.07	40.79	26.07	40.78	24.06	37.24	126.00
Soil + (NH 4) 2 SO 4 + super ...	54.75	23.91	36.70	25.80	40.30	26.33	41.27	24.32	37.72	126.68
Soil + green manure + super ...	59.75	23.10	33.06	23.71	34.31	22.98	33.10	21.38	30.41	131.00
Soil + green manure + super ...	59.75	23.18	33.20	23.57	34.10	23.18	33.44	21.63	30.83	131.00

SALIENT FEATURES OF MODERN RESEARCH WORK IN HORTICULTURE.*

By N. K. Das, L. Ag. (Hons.)

Investigation of the multifarious factors governing the successful cultivation of plants necessarily involves a considerable amount of experimentation. In fact, it is through experimentation that the cultivation of agricultural and horticultural plants has been developed from an empirical into a scientific art.

Field trials have always played a very important part in agricultural and horticultural research. Theoretically, it is necessary in such trials to eliminate or equalize all the factors which may have any bearing on the performance of the plants under study except the factor or factors whose effect it is desired to elucidate. In practice, however, it is hardly possible to exercise absolute control over all the conditions which affect the performance of crops under field experiments. The most common and prolific sources of experimental error which confront the horticultural worker are soil heterogeneity or positional differences and variation inherent in the material. It is a well known fact that the physical and chemical characters of a soil may vary a great deal even within short distances. Since horticultural field experiments often cover large areas of ground the effect of such variation may be considerable. There are also other factors, such as wind and disease, which in the case of horticultural trials may materially contribute to positional variation. Similarly, a wide range of variability, much wider than is commonly realised, may be shown by the individuals of a population of horticultural plants : and with such material it is extremely difficult to make experimental comparisons with any degree of accuracy. From these observations two things follow, namely :—

(1) That, if anything like a correct estimate is to be made of the relative effects of the experimental treatments or of the relative merits of the varieties under trial the lay-out of the experiment should be such that it ensures the maximum precision possible under the conditions of the experiment

* In preparing this article free use has been made of the Technical Communications of the Imperial Bureau of Fruit Production and other publications mentioned in the footnotes. The quotations are all from the Technical Communications except where otherwise indicated.

and enables the experimenter to make a valid estimate of the error and to eliminate the variations caused by positional differences.

(2) That the material should be as uniform as possible.

The consideration of the first of these two essential requirements has compelled modern workers to search for the most suitable methods of laying out horticultural field experiments. At the East Malling Research Station in England, different methods of laying out field experiments have been carefully examined and new experiments are now being conducted on improved lines. Modern statistical methods are also being applied for the analysis of the results. Fisher's methods of lay-out which are based on the principles of replication and randomization are regarded as the most recent advance in the development of technique for both agricultural and horticultural field trials. With these methods it is possible to make a valid estimate of the experimental error as also of the effect of positional differences. It has been claimed that by adopting these methods and using uniform material "it is quite possible to prove 10 % differences with small fruits, and there is no reason why similar accuracy should not be achieved with trees. Still another advantage of these methods is that several issues may be combined in the same experiment.

In field experiments with agricultural crops the question of variation inherent in the material is not of much importance but it is very important in horticultural trials. In the former case large numbers of plants are usually grown in the individual plots and their performance may be regarded as a more or less true indication of what the population as a whole would do under identical conditions. Moreover, agricultural trials can ordinarily be repeated for several years by fresh sowings, and consequently with new sets of plants, till the conclusions are definitely established. In horticultural trials the case is quite different. Here the plants often require considerable spacing and have to remain where they are planted for quite a number of years. This makes the inclusion of a large number of them in individual plots or their annual renewal quite impossible.

Some idea of the extent of variation which may occur among horticultural plants may be obtained from the observations made at the

Boquillas Coconut Plantation in Proto-Rico.* Twenty-four coconut palms were taken on each of the seven differently treated plots in a fertilizer experiment and divided into three equal groups, A, B, and C, of eight palms each for the purpose of comparing the average production of nuts per palm in the three groups of each plot. The record covers sixteen harvests extending over the period from July, 1913, to June 1917, and shows that on one plot the average number of nuts produced per palm in one group was quite double that in each of the other two groups, while, quite contrary to expectation the groups A and B of the check plot "in combined yield produced more than any two combinations of fertilized B and C sections." Great variations are also found to occur among other horticultural plants, as for example the citrus, and with such variable material it is often futile to attempt to prove even substantial differences between any experimental treatments. This fact was not recognized in the very early days of horticultural field experiments but now the necessity for using uniform material has come to be fully realised and attention is being consequently focussed on the standardization of fruit plants.

Standardization of fruit plants has also problems quite its own. Those plants which are naturally cross-fertilized and are therefore heterozygous and at the same time have to be propagated of necessity by seed (e. g. the coconut palm) would obviously show considerable variation and any attempt to standardize such plants must be a tedious and uncertain process. On the other hand, there would be no difficulty in getting uniform plants of those species which are naturally self-fertilized and are therefore homozygous. There are, however, very few fruit plants which would answer to this description. It may appear that exogenous trees which are capable of being propagated by asexual methods would present no difficulty in standardization. But the case is not quite so simple. It is doubtless true that those plants which can be propagated by means of cuttings would be easy to standardize since a cutting is always a true representative of the parent tree, or, as it is sometimes put, a chip of the old block. But those plants which have to be propagated by budding or grafting present a special case. It is needless to mention that the use of buds or scions taken from different trees at random is very likely to produce plants with a wide range of

* Bulletin No. 34, Porto Rico Agricultural Experiment Station. "Experiments with Fertilizers on Coconut Palms and Variation in Palm Productivity" by T. B. Mc Clelland. 1931.

variation. But this is not the only cause of variation in budded or grafted plants. Indiscriminate use of rootstocks may be as potent a cause as any other factor. In a trial of stocks for oranges at Peshawar "* W. Robertson Brown found that the rough lemon gave "greatest vigour and fruitfulness to the Malta", but the sweet lime produced " a dwarf tree with a few oranges of high quality" while the citron and the sour orange were" not suitable stocks for the Malta in North West India". Similarly, different species of citrus plants used as stocks for the *Sangtara* orange produced trees widely varying in their characters. This sufficiently proves that nothing but uniform rootstocks should be used in standardization. Not only that one particular variety of scions should be combined with one particular variety of rootstocks but it is also necessary that the scions and the rootstocks should each have a uniform genetic constitution.

Quite apart from the differences which may be inherent in the scions and the rootstocks, the character of the union obtained in budding and grafting is also considered as a possible cause of variation in budded and grafted plants. This would seem to suggest the adoption of uniform methods for the operations of budding and grafting.

In order to get rid of the rootstock factor in standardizing plants, which cannot ordinarily be reproduced from cuttings, horticulturists are on the look out for specil methods of vegetative propagation by which such plants also can be raised on their own roots. A very ingenious, though rather cumbrous, method is what is known as Y-cutting to which it is not possible here to make more than a passing reference. This method is said to have proved very successful with all citrus plants. Attention is also being paid to the phenomenon of polyembryony which is of common occurrence in plants of the citrus group. A seed possessing this peculiar character on being sown produces several seedlings of which only one may be the real generative offspring, the rest being-produced from the ovule tissue in a vegetative manner. If the generative seedling can be identified in the seed bed it would be possible to discard it and retain only the intrinsically uniform vegetative progeny. The work already done in this line shows that the generative offspring of complicated citrus hybrids can be picked out at a very early stage without any difficulty. Polyembryony is by no means confined to citrus plants alone but is also known to occur in the mango. Should

* Pusa Bulletin No. 93: "The Orange: A Trial of Stocks at Peshwar" by W. Robertson Brown, 1920.

any attempt be made to standardize this fruit this fact should not be lost sight of.

The selection of the original material which is to serve as the starting point in standardization requires much care. The worker must have a clear conception of the object he wishes to achieve with the plant on which he sets himself to work. In this respect he is to be guided by the requirements of the grower, the trade, and the consumer. Another very important point which merits the most careful consideration of the worker is the nature of the characters on which he is going to base his selection, that is whether those particular characters are hereditary and therefore capable of being determined by selection, or whether they are entirely the result of the influence of environment and therefore not capable of being influenced by selection. * Present knowledge on this question regarding horticultural plants appears to be rather meagre, hence the necessity is all the more for utmost carefulness.

From what has been said above it should be evident that the development of suitable methods for field trials with a view to ensuring maximum possible precision and the problem of standardization of fruit plants are intimately connected with each other. But standardization would seem to have a value of its own quite independent of the use that may be made of it in field experiments. It would enable fruit growers to assure the supply of a standardized produce to the trade which would be an advantage to the growers, the consumers, and the trade alike.

Early horticultural experiments such as those conducted at the Woburn Experiment Station in England and in various parts of America did not meet the requirements of modern field trials. Moreover, towards the close of the second decade of the present century, it came to be held in America that though the practical results of the early field experiments were not without value they were not sufficiently illuminating in proportion to the time, labour and money expended on them. They were also considered disappointing by those who had felt the need of principles of orchard fertilization capable of general application. Within recent years work has been started in the U. S. A. on new lines on the problems of fruit tree nutrition."......... attempts have been made to interpret nutritional conditions in terms of carbohy-

* See Leaflet No. 25, Series IV, Horticulture, Department of Agriculture, Forest and Fisheries, Palestine—"The Selection of Citrus Trees. Its Importance and Problems" by Dr. J. D. Oppenheim.

drate/nitrogen ratio. Following these lines attempts have been made to analyse the chemical factors associated with shoot-growth responses, fruitfulness and unfruitful conditions, blossom-bud formation, fruit set and biennial bearing, and no field experiment is now considered complete without parallel chemical and physiological investigations ". Laboratory studies and pot experiments conducted in the U. S. A. have thrown considerable light on the value of different plant food ingredients in tree nutrition. Very valuable work on " nutritional problems by laboratory and pot culture methods in addition to conducting comprehensive field investigations " has also been done at the Long Ashton Research Station in England. The main subjects studies at this station are, as put down by Dr. T. Wallace,

" (*a*) Effects of deficiencies of major 'essential' elements of nutrition.
(*b*) The diagnosis of nutritional problems in the field.
(*c*) Materials, soil conditions, and management factors in relation to nutritional conditions.
(*d*) The correlation of nutritional conditions and manurial responses to chemical composition of fruit plants.
(*e*) Pathological conditions—Leaf-scorch and chlorosis.
(*f*) Factors determining fruit quality."

The whole of the work done at Long Ashton is of considerable value to horticultural science but probably the most important feature of the work is the elucidation of diagnostic symptoms of various plant food dificiencies by pot culture methods. The investigations carried out point forcibly to a very profitable line of horticultural research. It is not possible nor is it intended here to go into the details of the experimental results ; suffice it to say that these are capable of general application to the fertilization of many deciduous and other fruit plants.

The most outstanding features of modern research work in horticulture have been briefly discussed above. They are :—

(1) Improved methods of lying out field experiments.
(2) Application of statistical methods.
(3) Standardization of material, and
(4) Intensive laboratory and pot studies.

India does not seem to have kept pace with these modern developments. Let us hope that under the guidance of the Imperial Council of Agricultural Research which is encouraging fruit work in different

parts of the country, rapid advances will be made in this direction in the near future.

FRUIT CULTURE.

By B. R. Phatak B. Ag.

(Continued from the previous Issue.)

PRUNING

Pruning or clipping of twigs and branches is among the routines of fruit gardening, particularly of deciduous fruits. It may consist in merely cutting down dead and unthrifty twigs or may extend to the cutting off of large portion or even whole of big branches. Big branches making the tree unshapely may be cut off. Branches of a pendant character and spreading laterally will have to be removed particularly when they interfere with the cultivation. As in oranges when the stem borer affects limbs and not the trunk, the affected limbs may be taken off. Big branches from the middle of the tree will have to be lopped off for the thinning of the dense growth thereby permitting proper aeration of these parts. The big branches are better severed close upon the stem, no portion of the branch is allowed to remain attached, as this interferes with proper healing. The growth of different parts is interrelated and pruning may often be required for balancing the growth. Decay of roots with water logging may produce unthrifty branches and twigs and their pruning may induce proper balance. Sometimes there is very heavy vegetative growth but no fruit production. A little root pruning under these circumstances may balance the growth and encourage fruiting. Decayed roots after pruning and subsequent manuring usually encourage the formation of new roots from behind the decayed portions; these new roots develop a better capacity to feed on the soil and would thereby in the course of two or three year's time give an altogether different and more vigorous look to the plant.

Pruning has however to be done judiciously or it may badly react on the growth. Different species of plants offer varied response to pruning. It will therefore have to be modified according to the circumstances.

Different authorities working with different species and varieties found different results obtained from like severity of pruning annually.

These differences are due primarily to growing and fruiting habits and secondarily to age, vigour and nutritive conditions, as well as to environmental conditions with which they may happen to be associated at the time.

Leaf surface and root system.—Any practice that may result in the reduction in the amount of new shoot growth and perhaps of spurs as well, would be expected to bring about a corresponding decrease in the leaf area and in the root development. Chandler's investigation of the influence of certain pruning practices upon subsequent root development show this reduction. In commenting on the data collected Chandler says :—" In effect the influence of a heavy top pruning on the subsequent developement of the tree is more or less comparable to that of root pruning. "

Pruning practices which do not reduce top growth in the trees of other kinds or of greater age than those studied would not have a great effect on root growth. It is significant that in young trees the pruning or the top has been found to greatly influence the extent of root development the following season. This suggests one of indirect ways through which pruning one season may influence growth and development 2 or 3 years later.

Tufts in California studying the influences of varying amounts of pruning on newly set apricots, sweet cherries, peaches, pears and European and Japanese plums found in every instance less rapid increases in trunk circumference with each increase in the severity of pruning. The found correlation coefficients ranging from 0.83 to 0.92 for trunk circumferences and weights of tops and coefficent ranging from 0.76 to 0.84 for trunk circumference and weights of roots, depending on the species. It is evident that trunk circumferences may be taken, other things being equal, as fairly accurate indices of tree sizes. Pruning in general results in a check to increase in size. At least this may be taken as established for deciduous tree fruits.

Pruning and fruit spur and fruit bud formation:—In young trees the less the pruning the larger the number of fruit spurs formed. With very severe pruning there is a great reduction. The checking influence varying greatly with the varieties. Data are presented showing also that severe pruning acts in a similar manner in decreasing the number of fruit buds that form on spurs. The ratio of flower clusters for the years 1909-1914 obtained by Bedford and Pickering in one of their experiments was 52 for hard pruning 100 for moderate pruning and 180 for no pruning.

There were corresponding differences in total yields. All these investigations go to prove that heavily pruned trees may be expected to come into bearing more slowly than those pruned moderately lightly or not at all.

On the other hand heavy pruning does not always result in low yields. Data obtained with Imperial apple trees that had been bearing for a number of years and were somewhat lacking in vigour show steady increments in yields with each increase in the severity of pruning.

	Yield in bushels. *Arakansas.*	Yield in bushels. *York.*
Heavy pruning	9.65	14.02
Moderate pruning	9.20	11.14
Light pruning	7.89	9.15

The heavy pruning must have had the effect of reducing the fruit spurs at least in comparison with trees pruned more lightly. Increased yield was then due either to the larger number of fruit buds or to the better setting of the blossom.

Influence on fruit size.—Experience and observations generally indicate that pruning does not decrease the size of fruit. Perhaps this tendency is more clearly shown in such fruit as raspberry, blackberry and grape which in the absence of pruning are inclined to set more fruit than they can mature properly, especially when supporting large amount of barren wood which unprunned plants of these species characterstically bear. Within certain, rather wide limits, the general influence of prunning is to reduce through the removal of actual or potential bearing wood, the amount of fruit that can set. It tends also to enlarge leaf area and though its effects are concentrating, it at the same time increases the, requirements of nutrients and moisture. If these are available in ample quantities pruning may result in an increased size of fruit if they are lacking it may result in a reduction, though the general tendency of pruning is to increase the size of the fruit. Its influence in this regard. is not direct.

Experience in the College garden has shown that in the cases of mango mulberry and guava at any rate, in the year of pruning few or no fruit buds are formed and in the succeeding year the blossoming is profuse and a large quantity of fruit is held. In Mulberry particularly the fruiting effect so produced vanishes in three years' time and fresh

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pruning is found necessary. Moderate pruning has not been attempted on these plants. It was all severe pruning. It may in fact be called thinning. Phalsa requires annual heavy pruning.

In general tree, bush and vine fruits should be pruned heavily when young to secure a strong stocky framework with well spaced limbs ; and of equal importance to prevent the production of fruit and even of fruiting wood. As the plant approaches bearing age and size, pruning should be less severe to permit or encourage fruiting wood. Perhaps in extreme cases it may be desirable at these stages to do no pruning at all. As the plant becomes still older, pruning is again increased in severity thus limiting or sometime reducing the amount of fruiting wood and in this way concentrating the energies of the tree upon a better support of what is left. This will however vary in detail, not only with different kinds of fruit but with varieties of the same kind and for the same variety from place to place; and under varying soil and environmental conditions.

Pruning method.—In kind all top pruning may be considered either as heading back or thinning out. These kinds produce quite different results, particularly as the pruning increases in severity. In general thinning out is accompanied by less new shoot growth but more new spur and fruit bud formation, than corresponding severe heading back. Heading back tends to make trees more, and thinning out less compact in habit. The different responses from the two methods of pruning are probably due in large part to the distinct nutritive conditions to which the practices give rise. Both methods have their places in orchard management, heading back being more useful in keeping the tree well shaped and thinning out in developing its fruiting, and in keeping that wood in good working order. As most trees grow older they should receive relatively more thinning out and less heading back.

Pruning may be coarse or fine with essential differences in attendant responses. Coarse or bulk pruning tends to disturb seriously the equilirbrium within the plant and generally results in the production of water sprouts. Careful fine pruning evokes much more general response.

Root pruning has a dwarfing effect. The influence of root pruning is in reality the effect irrigation and fertilization accompanying it. Girdling, notching and ringing have for their objects the promotion of fruiting

habits through interrupting the translocation of foods, and are attended with uncertain results.

Pruning Season.—Little difference is likely to result from pruning at different times during the dormant season though in certain fruits early pruning is followed by earlier foliation in the spring. This is a factor of commercial importance in grape culture. Very late pruning usually leads to more bleeding than early pruning. Bleeding from pruning would seldom harm the plant.

Summer pruning may have a dwarfing or an invigorating influence depending on its severity, kind, the stage of development of plant and in environmental condition—Particularly nutrient supply, soil moisture and light. A light summer pruning encourages fruit spur formation through favouring the development of larger and stronger lateral buds from which spurs are formed. It also provides fruit bud formation if done early in the season. Heading back tends to stimulate vegetative growth. Judicious summer pruning is more or less a conservation measure. This applies particularly to the removal of water sprout and other superfluous growth. In very strong vigorously growing trees 2 to 3 years old early summer pruning results in encouraging a late secondary growth and this may be a means of backing the general development of the tree if there is a long growing season and other conditions are favourable. A light summer pruning may aid materially the colouration of the fruit in certain species. Summer pruning encourages the development of secondary shoots.

Pruning citrus plants.—It is done in order to develop desired shape and size of tree and strength of limbs, and thus to permit the bearing of optimum crops of maximum quality without damage to the frame-work of the tree; which at the same time must be consistent with convenient and economic cultivation, fumigation and harvesting. Heading of citrus frees as practised in the United States of America is not much known in India. The usual height for heading is 33″. Heading is done after letting the tree grow 6″ taller than the height to which it has to be headed. It has long been the custom to prune orange trees very little, or none at all beyond the removing of water sprouts and dead brush. The tree resulting from this system is a dense bushy ball of foliage growing close down to the ground, with the fruit distributed over the surface on the ends of the outer limbs and twigs and the inside is an impervious

thicket of dead brush or a closely shaded open space if the brush has been removed.

Navel oranges of true standard type usually need little pruning. The best branches of a first class navel tree naturally become more or less pendant and gradually upon such horizontal branches upward growing shoots arise—the Nagpur orange however, does not produce pendant branches. They are stout and rise upwards. The shoots of are dimorphic in character. One form commonly known as sucker growth is large and rapid growing, its leaves are large.

The other type of growth commonly known as fruiting bush is more modest. It is thick set, fine stemmed and with smaller but well formed dark green leaves. This form will branch often and form frequent nodes and many flower buds. The suckers have bad fruit and destroy the symmetry of the tree. They should therefore be entirely removed.

In order that the short fruiting branch along the larger limbs shall produce a greater quantity of fancy inside fruit it must have light. The top and sides of trees are apt to get too thick and keep the centre too dark. To prevent this, the wall of filiage should be broken occasionally by taking out bodily, a few small branches from various places in the walls and tops.

Pruning of Lemons.—Young lemon trees should be cut back severely from the beginning. They should be curbed in their riotous growth and forced to increase in size slowly and by the addition of more or less crooked much branched fruiting type of wood. The big branches, usually thrown out by lemons may be whipped off by the wind and often break with the weight of the fruit. The main object should be to shorten back and strengthen the scaffold or main limbs, in order that they may carry their load nearer the center of the tree and be stocky and stiff enough.

Forsted trees should have all dead wood cut off. This should be started, only after clear distinction between dead and living is possible. This takes some time.

Pruning grapes.—Tne grape produces its fruit buds laterally on shoots which at the close of the growing season and for a year thereafter are called canes. These fruit buds give rise to flower bearing or fruiting shoots on which the inflorences appear to be lateral. However many shoots form few or no fruit buds particularly those springing on 2 year old or older wood, in other

words those arising from the arms, head, trunk or the crown of theplants. Only those shoots coming from the lateral buds on the canes of the preceding season are sure to form fruit buds, though under some conditions those coming from the older wood differentiate a limited number. Furthermore not all buds or shoots springing from the preceding year's cane contain flower parts. Those at the basal one to four or five nodes, depending largely on variety, seldom do. Though it is difficult and often impossible, to distinguish the fruit buds from the leaf or wood bud by their external appearence, their position on the plants offers a rather accurate index to their character.

Severity of purning.—Practically all grape vines each year differentiate more fruit buds than can grow into fruiting shoot and set and mature grapes in the following season. It is therefore unnecessary in pruning the grape to give thought to securing the larger numer of fruit buds. The real problem is that of reducing to just the right numer those that are already formed and normally would or could produce fruiting shoots the following season. Further more this must be done in such a way that the fruit will be distributed evenly and that new shoots on which fruit buds for a sueceeding crop are differentiated will be so located as to preserve the compactness and established form of vine. Both over pruning and under-pruning are harmful by, production of wood producing buds and over bearing undersized clusters respectively.

In practice proper distribution of fruit buds generally involves their location as near the head of the vine as possible so that the fruiting wood is not pushed out unnecessarily each season. Thus the plant is kept compact. In many varieties this is secured by retaining the lowest or basal cane on each arm or spur, *pruning* away those originating further from the head. In certain other varieties however fruiting shoots develop only from buds at nodes some distance from the base of the canes and more basal buds remian dormant, when the heading back is light enough to permit the development of fruiting shoots. Such variations require frequent pruning like that of dehorning in tree fruit. The usual method of handling vines of this type is each year to prune lightly or moderately certain canes for fruit production leaving them with the requisite numer of fruit buds and to prune severely other canes, so that all their fruit buds are removed and they are forced to develop vegetative bud shoots from the basal buds. These vegetative shoots then become the fruiting canes for the following year, while those that have borne

the fruit are entirely removed. These much shortened canes are spoken of as renewal spurs.

Kind of Pruniug.—In grape pruning, there is some thining and some heading back. In-variably all the past season shoots are removed except those retained for their fruit bud or for renewal or replacement. This is a thinnig out process. If the style of training call for pruning spurs, more of the last season's shoot must be retained. There would here be less thinning than in pruning to canes.

Pruning mangoes.—In India the only pruning given to mangoes consists in cutting dead wood. Since the fruit is produced at the end of the branchlets, general pruning of the tops can not be practised as with northern fruit. In Florida however several growers have found it desirable to prune out a certain number of branches from the centre of the tree so as to keep the crown open and admit light and air.

Experiments at Porto Rico A gricultural Station.—Pruning back the ends of branches, to induce blossoming has been practised with good result. In the operation from a few inches to a foot of the end of the branch was removed depending upon the stage of the maturity of wood leaving a few nodes from which the leaves had not fallen. From these nodes blossoms developed profusely, no blossom appearing on untreated branches. To secure the best results the pruning should be done in the late summer or fall several months before the flowering time. This method should be adopted on branches which are too low or too crowded or on those which have to be removed later to improve the shape of the tree, as after a branch is pruned, it makes little growth for several weeks or months or even for a year or more, after the fruit ripens; and by this time it may be well grown by surrounding branches. In girdling a band of bark was removed from a branch 1" in diamter in September these branches produced crops the following apring even when no fruits at all were borne on other brnches. Florida finds girdling done in late summer to be effective.

Root pruning.—is best accomplished by cutting into the soil with a sharp spade about 2″ inside the tips of the branches. In extreme case the cutting may encircle the tree to a depth of 8″ or 10″ in heavy soil and even deeper in light soils where the root system is considerably below the surface. Cutting at such intervals as to sever roots for one half to

two thirds of the distance around the tree, will induce blossoming under normal circumstances without checking the growth or the thrift of the tree.

WATER REQUIREMENTS.

On an average about 30″ of water per acre should suffice allowing for lossess on all accounts to maintain all orchards with only slight differences. This would be the result with proper and well distributed rainfall. There have not been lacking instances of orchards of maintained with proper orchard management and increased distances between trees, on a rainfall of 9″. In Tunis for instance olives planted at distances of 60' to 80/ instead of the usual distance of 18'—20' have been commercially successful without irrigation.

Danger from wet feet.—When water is supplied directly through irrigation too much may be added, excess may be just as disastrous as dificiency. Though plants require large quantities of water for growth, the roots that absorb it are composed of living cells that must respire. If the supply of oxygen is cut off for any considerable length of time by a rise of water table the submerged roots die. If often happens that trees receiving the heaviest irrigation or those growing on the lowest and perhaps the most fertile lands suffer most from lack of water, because their living roots are confined by the high water table to a very shallow layer of soil. In running water that is well aerated roots can live because they can extract the oxygen that is dissolved in water. Ground water however contains very little oxygen in solution, and roots will not penetrate a water logged stratum of subsoil, moreover submerged roots die of oxygen starvation. Ordinary fruit crops cannot grow in a soil that is nearly saturated with water. A soil that is half saturated with water, is in the best condition for ordinary plant growth.

Much perfectly good agricultural land is poor for fruit trees merely because the water table is high for a part of the year. During the growing season it may be deep enough for plants in general, including trees, and crops planted in after rains and harvested before rain may never suffer from excess of moisture. Trees however may suffer in the same soil because the water table rises to a high level in rains. In deep heavy soils fruit trees are very shallow rooted.

Failure of surface topograpy to conform to that of the subsoil ma

raise some difficulties in orchard lands. The surface may slope uniformly while the subsoil is full of hills and hog wallows. This causes the formation of areas of poor drainage, even on slopes where surface drainage appears perfect. The dead spots are sometimes replanted to trees many times over, when a few feet of drain would make one planting a success. Orange garden here is a living example of this fact.

Good orchard land should be deep with excellent drainage and a permanently low water table. In a soil of this kind trees can develop a deep adequate root system, a root system that makes the tree independent of weekly seasonal or even yearly fluctuations of rainfall; fortified against occasional or periodic draughts, resistant to winter cold and perhaps less likely to be in constant need of fertilizer application.

A studious fruit grower has to orient condition in his own locality with reference to those elsewhere. A soil considered fairly moist in one locality may be considered dry in another.

It may in general be said that we in India add too much water by irrigation and a very large saving is possible without detriment to the outturn. In many orange gardens round about Nagpur drainage may reduce the water requirements and keep fruit trees more healthy. The college garden has shown immense improvement due to drainage, and the number of irrigations allowed is far fewer than with the cultivators. Here one irrigation is given in a month as against one per week by the local orchardists. Even bananas have thrived well here on one irrigation per three weeks as against one every four or five days.

Extracts

THE COST OF SOIL EROSION.*

By H. H. Bennett

The Problem.

Unrestrained soil erosion is rapidly building a new empire of worn-out land in America: Land stripped of its rich surface layer down to poor sub-soil, and land gullied beyond the possibility of practical reclamation.

* In the Ohio Journal of Science Vol. XXXIII, No. 4 July 1933.

This wastage of the nation's most basic and indispensable asset is not merely continuing; it is speeding up. Over millions of acres the washing is be coming more rapid as the cutting away of the upper soil material lays bare the less stable substrarta. Every rain heavy enough to cause water to flow across cultivated slopes and sparsely vegetated land removes part of the soil. Everyone sees this in the muddied waters flowing away to the oceans, but few think of the material that discolours these flooded waters as soil material swept from the surface of the fields, where lies the most productive part of the land.

No other agency or combination of agencies remotely approximates the impoverishing effect of rainwater running wild across the slopes of America's farm lands. Three fourths of the agricultural area of the nation is sloping enough to favour ruinous cutting away of the vital substance of the soil through the abrasive action of water. More than 100 million acres of the 350 million in clutivation have lost all or most of the precious material we call the top soil. At least 160 millions acres of the remainder are suffering in some degree. To date we have permitted the essential destruction of about 35 million acres of what formerly was largely good crop land, together with an enormous additional area of grazing land. This has been so deeply washed, so cut to pieces by gullying or so smothered with the products of erosion that it cannot be reclaimed upon any practical basis by the average farmer. Much of it is permanently destroyed. Bedrock has been reached in countless places and deep gullies have torn as under millions of sloping acres. All of this has been abandoned.

No other part of the western hemisphere has been so wasteful of its land resources as we of America. Probably no nation or race of all history has permitted its agricultural lands to go to waste so quickly. Other parts of the world have been ruined by erosion, but the lands were used for many centuries, even thousands of years, before their devastation was completed. The enormous impoverishment and destruction that we have permitted, even encouraged by lack of interest and foresight, has taken place with but two centuries of cultivation. Most of the depletion has been accomplished during the past fifty to seventy-five years. This has come about because of carelessness, ignorance and the physical peculiarities of our soils, rainfall and farm methods. With respect to land use, we have proceeded, and continue to proceed, without plans. We have used all kinds of lands, occupying every degree of slope, indiscriminately for every conceivable purpose. There has been too

little of orderly selection of the basis of adaptability and fitness, and almost no effort has been given to the vitally important matter of soil conservation. We have looked upon our vast domain of agricultural land as limitless and capable of enduring for ever. Because the vast areas which have been made so poor that a man may spend his lifetime upon it without bettering himself or his farm will still grow something we continue to produce an abundance of everything. The point of gravest menace is not a matter of producing a sufficiency of food. We shall be able to meet our requirements of both food and cloth-ing for many years to come. But how? What is the menacing aspect of this evil of erosion?

The sore points deserving immediate serious consideration are these: Our best lands are largely in use and have been for some time. The area of these more favourable soils is steadily diminishing as the result of excessive rain-wash. Acreage yields are declining in spite of all the education and experimentation devoted to improvement of methods, and in spite of increased use of improved varieties, better seed, better machinery, high grade fertilizers, soil-improving crops and irrigation along with continuing abandonment of worn-out land for land still retaining its top soil. Cultivation of erosion-exposed clay is more difficult and costly, and need for fertilization and building up of the soil is steadily increasing. Water flows across the impervious clay exposed by the stripping off of the mellow, humus-charged top soil more rapidly to augment floods. Tens of thousands of hard-working farmers already are sub-soil farmers. Sub-soil farming is an impoverishing type of agriculture. Although producing a large aggregate of crops, the average yields at this low level of soil productivity are so pitifully meagre, there is but slim opportunity for the operator to get ahead, whether prices are up or down. Reservoirs that were built to hold water, not solid soil material, are rapidly filling with mud washed down from unprotected slopes; stream channels are silting up and over-flows are becoming more frequent and destructive. Vast areas of alluvial land of extraordinary original productivity are being covered with infertile sand and gravel; large sums are required to protect the embankments and roadside ditches of our highways and railroads; and flood protection calls for the expenditure of everincreasing millions.

From every conceivable angle erosion is a devastating agency. It is the greatest thief of soil fertility. It steals not only the plant food contained in the soil but the whole body of the soil, plant food and all. When this productive material that required centuries in the building is

washed out of fields it cannot be economically hauled back, even where it is washed no farther than from the upper to the lower slopes of fields. That which passes down into the beds of streams and on out to the ocean is lost as irretrievable as if consumed with fire. Our best estimates indicate that erosion steals 21 times as much plant food as the crops take out of the land. That removed by crops can be restored, but that taken by water and wind cannot be restored. It is a net loss of almost incalculable magnitude. The process is the principal cause of worn-out land. There can be no permanent cure of dangerous floods so long as this principal contributor to the evil remains unleashed. Higher and broader and more costly levees may be built, but they cannot insure any permanency of protection with ever-increasing volumes of water charging out of erosion-denuded uplands.

Our surveys and soil loss measurements indicate that at least 3,000,000,000 tons of soil are washed out of the fields and pastures of the United States every year. The value of the plant food contained in this amounts to more than two million dollars, on the basis of the cheapest fertilizers. Of this almost inconceivable wastage, the direct loss to the farmers of the nation is less than S 400,000,000 every year. This is paid for in reduced acreage yields, increased cost of cultivation, fertilization and the growing of crops for the sole purpose of building up impoverished fields, in land abandoned, highways damaged, reservoirs, irrigation ditches and culverts choked with erosional debris, and accumulative thinning of the surface soil, the staggering cost of which is postponed until the last inch of soil is washed off.

In a single country of the old South Carolina Piedmont country, where farming has gone on for nearly two centuries, ninety thousand acres of once good farmland have been mapped as soil largely permanently destroyed by gullying. Countless ravines have chiselled to pieces former fields, exposing bed-rock in numerous places, and all the soil has been lost. One farm of 1,004 acres, 200 of which were cleared of the virgin timber just after the Civil War, has not so much as a single acre of good farmland left in one place. No one lives on this once magnificant plantation. The palatial residence has tumbled to ruins. Silence pervades the desecrated acres and all the surrounding country is much the same.

The same survey has shown in the same county forty-six thousand acres of stream bottom, formerly the best land of the entire state, which have been converted into swamp or so smothered with sand washed out of the hills that it no longer has value for crops. The stream channels

are so soaked that every rain of any importance sends flood waters over the alluvial plains.

Eight miles west of Lumpkin, Georgia, is the largest man-made gully of the western hemisphere. This chasm is 200 feet deep. It has started by the drip from the roof of a barn fifty years ago. Since then it has swallowed the barn, a schoolhouse, a tenant house and a graveyard with fifty graves. In addition to this huge gulch, there are thousands of others nearly as large. Altogether seventy thousand acres of the best farmland of the region have been permanently destroyed in one country by this irreparable devastation. To fill these gullies would require operations on the order of those employed in the construction of the Panama Canal. And yet, every one of them could have been stopped easily in their infancy, had the farmers known of the necessity and of the practical methods of procedure.

In five adjoining Alabama countries, 500,000 acres of formerly cultivated land, most of it once highly productive, have been worn out with gullying and deep sheet washing. This is largely abandoned. Fortunately much of it is growing up with pine trees. The growing of trees is the best possible use for such land.

In one country in south-eastern Ohio, soil survey made by the State and Government co-operating shows that nearly 200,000 acres of formerly cultivated land are no longer cultivated. Approximately half of this has been so terribly imporverished by erosion. that it is no longer used for any purpose. First it was farmed, then turned over to pasture; now the fences have fallen down and only poverty grass, golden-rod and weeds are growing on it. This too could have been saved had the farmers known 50 or 75 years ago what we know today.

That the consciousness of the nation has not been aroused to the seriousness of this prodigiously costly evil is an ugly blot upon our record. In our text-books we read of vast expanses of grass-covered priaries, of the buffaloes that grazed over these virgin glasslands : and we read of the enormous extent of our eastern forests and the fertile lands from which these have been cut. But we read little or nothing in these volumes of the desecration of these same areas following the breaking of the prairie sod and the cultivation of the lands that supported the forests ; the destruction of millions of acres and the impoverishment and increasing impoverishment of a large proportion of the remainder. Are our children to believe that the present gullied and soil-skinned slopes of the nation represent normal conditions, or shall we tell them the truth in order to

implant the germ of Moral obligation to country and posterity which eventually would arouse that mobility of consciousness so vitally necessary for correction of our unwise land use practices. If this not done, if we continue as in the past cultivating steep lands and lands that wash away within a few short years following the first plowing, there can be but one outcome: Irreparable decline of the nation's most basic resource, its agricultural lands. This is not so much a prediction as an obvious physical eventuality based on the known depth on the productive topsoil and the known rates of the soil removal and depletion by erosion.

At the moment there is wide-spread discussion of the evils of erosion and the necessity for controlling it. Some of these discussions seem to imply that all we have to do is go out and stop the wastage. We are fully aware of the fact that forests and grass and the thick-growing plants such as lespedeza, alfalfa, sorghum and sweet clover, will largely reduce the washing; but we must continue to produce clean-tilled crops, as corn, potatoes, cotton and tobacco. It is in fields of these crops that the evil is so vicious and calls for immediate attention. There are various remedies and partial remedies. Some methods, effective on one soil occupying a given slope, are of little value for other soil conditions. For many kinds of land we have not yet ascertained the most economical and effective measures of control. The national program of soil erosion, described below, is striving with the greatest possible speed to develop the acutely needed methods for such lands.

In the discussions now going on a great deal of emphasis is devoted to gully control. Much good could be accomplished in this direction especially in regions where gullying is widely prevalent; but on the whole necessity for gully control is of inconsequential importance in comparison with the need for control of sheet washing: That process of erosion which planes off a thin layer of soil with every rain heavy enough to cause water to flow across cultivated slopes. This process goes on so slowly that little attention is given in until infertile sports of clay sub-soil and solid rock begin to make their appearance in fields, at which stage it usually is too late to very much in the way of soil conservation, the soil having largely floated away in the direction of the oceans. Gullying usually begins at that stage of sheet washing when the soil is all gone.

Another unfortunate feature in connection with the erosion problem is that only a handful of soil specialists know how to distinguish sheet washing and to measure its effects. Practical capability in this important

field calls for special knowledge of soil varieties, their morphological structure under virgin and cultivated conditions and their varying tendency to wash, as determined by soil type. Sheet erosion can be identified and its effects measured only by comparing eroded areas, soil layer by soil layer, with the original condition in woodlands and grass-covered areas. What will happen to a given area of a definite soil type if put into cultivation can be predicted only through this method of comparing and interpreting natural and abnormal soil conditions. What one kind of soil will suffer on a given slope frequently is entirely different from what will take placc on another soil having precisely the same gradient. This is one of the most fundamentally important aspects of the erosion problem, and without due consideration of these variables erosion-control programs will suffer or come to nothing.

The National Program of Soil and Water Conservation.

Finally, recognizing the enormous cost of soil wastage by erosion and excessive loss of rainwater as run off from unprotected cultivated slopes and from overgrazed ranges and pastures, Congress three years ago appropriated funds to begin a national program for studying the whole problem of erosion and for developing methods of countrol. The plan calls for accurate measurement of the losses of soil, water and fertility from various-slopes undergoing different cropping treatments throughout twenty odd major regions of the nation where erosion is known to be a problem of enormous seriousness. To date, ten of these erosion experiment stations have been established.

At these stations every promising practical method for slowing down erosion is to be tried out on a field scale. Rates of soil loss and run off are to be accurately determined from the different slopes planted to different crops and tilled in various ways. Terracing, strip-cropping, scarification of the land and other methods are being tried out, first on small plots and then in large fields, wherever the results have shown any promise of practical applicability. In some regions where livestock farming is important the land is being subjected to various conditions of grazing, in pastures containing a variety of grassess and other forage crops. The cheapest methods of reclaiming erosion-worn land are being determined, together with the cost. Various methods of gully control are being tested, using living dams of grass, trees, shrubs and vines, rock dams, dams made of poles, brush and other cheap materials. Conserva-

tion of the remaining soil, however, will be the prime endeavour of the program, rather than reclamation of depleted land.

As soon as the work at the station gets well under way, every experiment of worth-while promise will necessarily, constitute a demonstration. Field meetings are held on the farms at frequent intervals so that the farmers of the region may visit the station and see what is going on. The educational phase of the work is being pursued in such manner as to acquaint the regional farmers with the precise meaning of erosion, its cost and the best methods for its control. There is no secrecy about any part of the program. Visitors are urged to come to the station from the very beginning of the work. They are urged also to bring to the specialists on the erosion farms any suggestions they may have which are based upon worth-while practices on their own farms, in order that every promising practice may be brought clearly out before all the farmers of the various regions.

To cite the work at one of these erosion farms: The Red Plains erosion station near Guthrie, Oklahoma, is located on the principal type of farmland in this highly erosive region, which comprise thirty-six million acres in Oklahoma and Texas. An erosion survey recently completed by the Oklahoma Agricultural College has shown that of the sixteen million acres under cultivation in that State, thirteen million acres are suffering seriously from erosion, nearly seven million acres of this having reached the stage of gullying. More than a million and a half acres have been ruined by deep washing and gullying during the past ten years. The annual cost of erosion to Oklahoma has been estimated by the State agricultural specialists to exceed S. 50,000,000, under normal price conditions with respect to farm commodities.

The work at the Red Plains station has shown that when the principal regional crop, cotton, is grown continuously, the loss of soil from the average slope amounts to 32.5 tons per acre per year, along with a loss of 14 per cent of the total precipitation as run off. This means that under cotton only 30 years are required to wash off the entire depth of the surface soil, down to stiff clay sub-soil, which produces less than half as much cotton as the uneroded topsoil.

The results show, on the other hand, that on precisely the same kind of soil and the same degree of slope only 0. 03 tons of soil and 1. 7 per cent. of the precipitation are lost where grass is grown. In other words, grass reduced the soil loss by 1,080 times and the water loss by 8 times.

Where cotton is grown in rotation with grain and a leguminous crop, the loss of soil is reduced by 350 per cent. and the loss of rainfall by 23 per cent as compared with the losses under continuous production of cotton.

Beyond this, terracing and strip cropping have very largely reduced the erosion. The farmers of the region are visiting the station daily, and more and more of them are putting into practice the soil-saving and water-conserving methods which have been worked out on soils like those on their own farms.

The work, such as is proposed for the erosion stations, should have been begun 50 or 75 years ago. At this advanced stage of our civilisation we have not yet obtained the fundamental facts relating to the erosion problem, such as are vitally necessary for the carrying out of protective measures. If this work should be delayed the problem of erosion control would simply become progressively more difficult, more expensive and more discouraging. It is a problem that must be attended to now, not something that can be put off for future generations to solve. No moratorium can be declared against erosion. It must be fought with determination and effective implements. If we refuse to ascertain what these implements are, then the fight will be lost, or seriously retarded, farming on sloping land will become steadily less profitable and finally altogether hopeless. Floods will flow down the rivers of the nation in ever-increasing volume. Co-operation from every thinking individual is needed in this combat. Let us remember that erosion is the most powerful agency affecting the physical character of the earth, and let's not forget that already we are very late in getting started the studies which should have been made first of all the studies having to do with land use and the maintenance of soil productivity. We cannot afford not to pursue this problem with all the energy at our command

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ORGANISATION OF AGRICULTURE.*

By Sir Daniel Hall, K.C.B., F.R.S.,

It used to be said that the greatest public benefactor was the man who could make two blades of grass grow where one grew before. Not so to day, when the nations are considering agreemnts to restrict output and even destroying the products of the soil. The man of science must

* From the Alexander Pedlar lecture of the British Science Guild delivered before the Cambridge Philosophical Society on November 6, 1933.

take up an apologetic attitude at the present time with regard to agriculture. For two generations he has been entreated to make the land more productive and to reduce costs; but as an American professor of agriculture writes to me: "Ten million acres of cotton and some thousands of tobacco have been ploughed under. The lastest move is the killing of some 5 million pigs weighing under 100 lb and the slaughter of some 200,000 prospective mother sows. If this will bring national prosperity I have wasted my life. "The man of science may be forgiven if he concludes that he is no longer wanted and may retire to his ivory tower, but whatever food for irony the world spectacle presents, he will not be allowed to enjoy it in detachment, for if the deluge comes he will be swept down with the rest.

I propose to inquire a little into the causes of this paradoxical situation. In the first place, the agriculture of the word is predominantly a peasant industry. In Great Britain, we have developed in much an exceptional fashion, for only 6.6 percent of our workers are engaged on the land, that we do not always realise how much we stand apart. But in France 41 per cent, in Germany 34 per cent. in Czechoslovakia 40 percent, in Poland 76 per cent, in the United States 26 per cent are so occupied. At the extremity of the scale, in the East, the proportion of the pouplation engaged upon the land may rise to 80 per cent, and in large districts in China even to 90 per cent. Taken alone, these figures do not tell the whole story: more significant is the fact that they are mostly made up of single handed independant occupiers of land, employing only their own labour and that of their faimly. In all the European countries except Holland, the independent holders of land outnumber the paid labourers.

The typical English farm is one of about two or three hundred acres carrying half a dozen or so hired labourers. There are, of course, capitalist farms, often of large size, in all countries, as for example the great demesnes of eastern Europe, though the whole trend of policies since the War has been to break these up into single family units.

The advent of science has enormously strengthened the economic position of large-scale capitalist farming, particularly the recent progress in power machinery, of which the full effects have not yet been realised. Efficiency of production has advanced to a degree difficult of estimation; indeed, were agriculture, like any other industry, governed only by the free play of competition in the pursuit of profits, the family farm would long ago have been displaced. But two opposing factors have been at work;

in no old settled country is land a free commodity; custom, even law, tends to perpetuate the old divisions of the land, and the capitalist can rarely buy an area for extensive farming as he can buy a factory site. Despite the increased use of machinery, manual labour is still a large factor in agricultural production; the capitalist has to pay for labour, but the peasant does not count his long hours or the assistance of his wife and children.

A century ago factory did not at once displace the hand loom, and in the case of agricluture the solitary worker has the additional advantage in the struggle that he is at least producing food for his family. But the final out come cannot be in doubt: organisation with capital, power and science at command, in other words the machine, must win, provided free competition is allowed to rule.

State organisation of agriculture in some form has become inevitable; many branches of farming in Great Britain would perish if they were not 'nursed'. The question remains, what form shall the organisation take?

We have one example before us in the Russian plan. This represents what we might call an engineer's lay-out to obtain maximum efficiency of production from the land, given a perfectly clean sheet as to land, labour and capital, without any hampering conditions other than those imposed by soil and climate. It is the method of industrial exploitation such as we see at work in some of the great farms of the United States and of tropical countries, raised to a higher power, from thousands to millions of acres, by the all-controlling State organisation. Its aim is to secure from the soil the food and other raw materials required by the nation by the minimum employment of man-power, made effective by the application of science and machinery, thus liberating greater proportion of the labour hitherto so employed for other forms of production which will add to the real wealth of directive skill and a technique of national organisation which only began to be attempted during the War. It necessitates social revolution which no other country is prepared to carry through.

What alternatives are there, methods that will give play to economic efficiency and yet be tender of the initiative and enterprise of the individual? Can we eventually transform the social structure of the countryside without beginning by breaking it? In the organisations that have been set up to bring the producers of each commodity into selling corporations, we see the beginnings of such a system. It is perhaps not generally realised how fundamental a change in the

conduct of the agricultural industry of Great Britain has been wrought by recent legislation. Provided a certain proportain of the producers of a given commodity demonstrate their case to the Minister of Agriculture, he can give to their combination a monopoly of the right of sale; no producer outside the combination may sell to the public, all the members of the combination must all through it. These powers of combination and control can be extended to any intermediary manufacturing process intervening between the producer and the retailer prices will be fixed and production regulated by the limitation the corporation will put on the amounts it will sell for each producer. The power to determine internal prices will ultimately depend on the regulation of the volume of imports and the duties that are to be imposed. The Government has undertaken to apply one or other of these measures as a necessary part of the new policy to stimulate home production. The object is to ensure stable prices, no longer subject to the devastating influence of foreign competition, often forced and illegitimate. In brief, producers and processors of any agricultural commodity can now form a guild, which will be endowed with a monopoly, and directly or indirectly will exercise complete control of all production for sale.

The organisation aims at removing the great criticism that can be levelled against the agricultural community, that its average practice is much below the performance of the best farmers. In future, if a farmer is to sell pigs at all he will have to forgo many of his preferences for particular breeds or methods of feeding, and to bring forward pigs that have been bred and fed on the lines laid down by the corporation, on instructions that are the outcome of knowledge and experiment. Hitherto such knowledge, in so far as research has made it available, has been left to permeate by means of advice, but the results have always been slow and imperfect because the economic advantage of the improved method is generally of an order that is easily obscured by the accidentals of farming, especially as accurate recording has not been common practice. Such a co-operative but controlled organisation is the only one I can see that can compete with the Russian plan of complete unification of the industry, and at the same time retain the essential freedom of the individual.

Such corporations will be able and, if they are to be acceptable, will have to enforce certain reformations in their particular industry which may not be of any great profit to the farming community but may be required by the consumers. To state one such case, it is possible to free the dairy herd of the country from bovine tuberculosis, which would not

only mean greater safety to the health of the general population but also would cheapen the production of milk by reducing one of the considerable items of cost, the relatively short life of the average dairy cow. In so far as the milk producers as a body have to be paid for the costs of production, whatever they may be, no gain to them would accrue by the elimination of tuberculosis; the new cheapness would be passed on to the consumers. The controlling corporation, which must consider the interests of the general public because from them it derives its monopoly and price-fixing power, can embark upon such a scheme. It can take the long view and adopt a scheme which despite its prime cost will ultimately both cheapen and improve the product.

It is indeed a necessary part of the new system, if these corporations are to become efficient elements of the national economy, that there should be some superior organisation planning and directing their work in the national interest. otherwise the corporations may easily degenerate into guilds concerned only in maintaining a price-level that will enable their members to carry on automatically on the old lines. It would be for this central body, personified in the Minister of Agriculture, to decide which branches of the agricultural business in Great Britain should be encouraged to develop and which should be subjected to the brunt of economic pressure, whereby they would be either transformed or abandoned. To take an example, it is inevitable that there will be, in the future as in the past, strong pressure from an important section of farmers to maintain a remunerative price for wheat. Now while wheat may be almost a necessary element in the current rotation on certain types of English soil, it should be regarded as a by-product rather than as the main object of the farming system. For our farming can and should pick and choose, specialising primary commodities like wheat. Considering the ratio that our land fit for cultivation bears to our population, we cannot be self-suppoting as regards food, except at fantastic cost or by reducing excessively the standard of living. In Western agriculture as at present carried on, two acres and upwards of land are employed in producing the food, etc. ,consumed by one unit of the population. Since in round figures the cultivated area in Great Britain is only 45 million acres, to provide for an approximate population of 45 million, it will be seen that the land available is far from sufficient except under an intensification of production that is impracticable.

The fundamental truth is that, whatever may be the increased efficiency of production that science has put at man's disposal, it will be

still insufficient to satisfy the reasonable demands of the population, when each in turn is producing some commodity that can be freely exchanged. It is precisely in this difficulty of exchange that the plight of the agriculturist resides, all the world over, and if we take a world point of view, we see that agriculture cannot lift itself out of its depression by its own efforts. Farmers are the primary producers, the first sellers in the chain of commerce, but they are waiting upon a renewal of the power to buy on the part of their customers, that is, the industrialists and the people at large. whatever may be our power to revive British agriculture, because within our borders there is such an immense margin between our actual production and our consumption, yet world agriculture cannot revive until the wheels of international trade begin to go round more freely.

Gleanings

Better Cotton.— Marked improvement in the staple quality of American cotton in the last four years is reported by the United States Department of Agriculture on the basis of grade and staple analyses made in co-operation with state experiment stations. The improvement has been most marked in that part of the crop which had been most criticized as having deteriorated in quality says the department. For example, 20 percent of 1929 crop was shorter than 7/8 of an inch length of staple but only 6 percent of the 1932 crop was shorter than 7/8 of an inch. The improvement in the shorter cotton has been so great that the crop as a whole has gained almost 1/32 of an inch, attaining last year an average of 15/16 of an inch, according to the official standards of the United States. This length is eqivalent to 1-1/16 inch staple according to old concepts still used by some reporters in other countries where, also, cotton which was 1 inch in staple according to United States standards has been described as commercial 1-1/8 inch. (*Scientific American*).

The Residual value of Lucerne.—The outstanding value of lucerne as a fodder crop has long been recognised in most countries where climate and soil favour its growth but for various reasons this crop has failed to make any important headway in Great Britain. The discovery at Rothamsted of a successful method of inoculating unfavourable soils with the necessary nitrogen-fixing organism, and recent experimental work on drying the newly-cut crop by artificial heat, have, however, combined to direct renewed attention to its possibilities, and it is well possible that we may shortly see some interesting developments. One great

advantage of lucerne is its high cropping power : another is its high nutritive value ; and a third, which is sometimes overlooked, is its high fertilizing value : it enriches the soil with humus and with nitrogen, which remains available for succeeding crops over a long period of years. Now the relative value of lucerne and other legumes as sources of soil nitrogen has never been satisfactorily determind, an it is therefore very interesting to note that the records of Rothamsted have recently been examined with this end in view, and that Mr. Hugh Nicol, of the Rothamsted staff, has described the findings in the current issue of the Empire Journal of experimental Agriculture, issued by the Oxford University Press. Mr. Nicol's researches show that at Rothamsted the residual value of lucerne has been much superior to that of other leguminous crops—beans, peas, Bokhara clover, sainfoin, white Dutch clover, broad red clover and vetch. The experiments upon which this conclusion is based were initiated by Sir John Lawes as long ago as the year 1878, and have been continued by his successors, Sir Daniel Hall and Sir John Russell- They supply information which does not appear to have been obtained anywhere else in the world, and they add a further argument for the extended cultivation of lucerne. (*Agriculture and Live Stock in India*).

Effect of Weed-killers on the Soil.—A question of importance in the use of chemicals for weed eradication is the possibility of such compounds exerting a deleterious effect on the soil, with risk of injury to the subsequent crop. Some investigations on these lines have been carried out by W. E. Bowser and J. D. Newton (Canadian J. Research 8, 73). The liability of damage depends in part at least on the rate of movement in the soil, and its effect on microbiological activity. Sulphuric acid and copper sulphate, which are employed chiefly as leaf sprays for the suppression of annual weeds, showed no lethal effect on the soil, and nitrification was not affected. Sodium chlorate, on the other hand, which is mainly used for the eradication of perennials, remained undecomposed for a considerable time, poisonous effects being found nearly two years after application had been made. The rate of decomposition, however, was accelerated in the presence of much organic matter, and leaching removed the toxic compound from the surface layers of the soil, facts which suggest that a shallow rootted crop supplied with a good dressing of organic manure would be advisable after a sodium chlorate treatment. Sodium bichromate decomposed rapidly, showing no residual toxic effects, but both this compound and sodium chlorate were alike in exerting a depressing influence on the numbers of soil microorganisms. (*Nature, Vol. 131, 1933, p. 880*).

Sharpening a Steel Ploughshare.—Build a fire on the forge suitable for this particular work. This is done by banking the fire, allowing only a small opening in the side for the blaze and heat to escape. Commence with the point of

the share. Insert this into the fire just far enough to heat the part you wish to draw, never permitting the heat to extend farther back on the share than is absolutely necessary. Draw this down to the proper shape and thickness, which should be as near the original level as possible. After the point has been finished, work back towards the heel or wing of the share, never heating more than 1½ inches from the edge and 2½ inches wide. It is important to keep hammering after the steel has changed from a red to a black heat, as this makes the edge tough and hard, giving a wearing surface that will last much longer. If once down the share is not sufficient, reheat, but confine the heated part to the foregoing measurements. In working along the cutting edge, keep it straight. In so doing you will avoid having to go back and reset the edge. After a solid steel share has been set as instructed, it should be reheated to a cherry-red and left to cool in the air ; it should never be submerged in water or oil. (*Agricultural Gazette of N. S. W. October 1. 1933*).

Fermentation of Tomato Pulp Gives Disease-Free Seed.— An accidental circumstance observed and interpreted with scientific understanding bids fair to relieve tomato growers of losses caused by the bacterial canker disease. The results, announced by H. L. Blood of the Division of Horticultural Crops and diseases, also provide an example, say officials of the Bureau of Plant Industry, United States Department of Agriculture, of how technical progress in farming sometimes creates a new problem that requires solution.

Bacterial canker, a serious disease affecting tomatoes, has been much more common and destructive since 1927 than it had been before. Scientists of the United States Department of Agriculture and at several state experiment stations learned that the seeds carried the disease and have been experimenting with various chemicals as disinfectants. In recent years, canneries and seedsmen have been using high-speed power machinery for extracting tomato seed from the ripe tomatoes. In general, the older and slower method of placing tomatoes in vats to ferment until the seeds loosened from the pulp had been discarded. But Mr. Blood had a lot of tomatoes which he knew were infected with the canker disease. He wanted this infected seed for tests of disinfectants. He did not have a power extractor, so he went about it in the discarded way. by fermenting the fruit pulp. From this lot he planted untreated seed, and seed treated with various disinfectants, and to his surprise he found that the untreated seed which came from severely infected fruit was practically free from the disease as good as or better than disinfected seed from the same lot. He repeated the experiment in Utah, where the disease has been destructive. Again the fermented seed from infected fruit proved free from the disease' and for this

reason superior to mechanically extracted seed. It seems evident from the experiments so far that seedsmen will have to abandon power extraction of tomato seed and go back to using the vats in which the tomatoes were fermented, and in which they developed a solution which seems to have disinfected the seed more reliably than any commercial substitute. (*Scientific American*).

A Plow for Reforestation.— A forestry plow especially made for reforcestation work is now available. The plow has been developed by Professor S. O. Heiberg, of the New York State College of Forestry, Syracuse University, in co-operation with engineers of the John Deere Plow Works and the Syracuse Chilled Plow Company. Following in the footsteps of its causin, agriculture, forestry is taking into its service the machine. During the last three years trees have been planted in many places by machines instead of the grub hoe, and now the forestry plow appears. It is a tractor-drawn implement which removes the sod to a depth of about two inches from an 18-inch-wide strip and then cultivates this strip by means of spring teeth and subsoiler so the soil is in excellent shape for planting. Different combinations and adjustments make the plow equally suitable for heavy and light soils. The depth of cultivation of the cleared strip can be adjusted from very superficial scratching of the surface down to a depth of 12 inches.

The machine can be handled by the tractor driver alone as the levers are adjustable for different tractors. Experiments conducted by the New York State College of Forestry show that with a six foot spacing between the center of the strips, the plow can prepare one to two acres per hour. With all expenses included, the preparation of one acre thus costs from 75 cents to S. 1.50 or $\frac{1}{2}$ to $\frac{1}{4}$ the time for hand made holes, and the strip is much better prepared than it would be economically possible to do by hand. Planting in such a strip is extremely easy and the young trees have a better chance for survival and development than if they were just planted in holes. (*Scientific American.*)

Current Research.

Biometric studies in Sorghum. The relation of yield to other characters in Andropogon Sorghum.— S. N. Venkataraman and P. Subramanyam. (*Ind. J. Agric. Sci.* 3, 609.) (1) The object of the present paper is to investigate the economic significance of some of the quantitative characters usually studied in sorghum breeding. The relation of the yield of the single plant to the other quantitative characters was studied both from plant to plant of the same strain

and from one strain to another in a number of strains. A widely varying material was examined comprising genetic variation, differential field effect, border influence and manurial response and the relationship of characters was determined under all these conditions. (2) The characters circumference of head, diameter of peduncle, length of head and height of plant exhibit positive relation to yield in the order of importance, while the emergence shows a negative effect. The relationship was very pronounced in populations of the same strain, while from strain to strain they were much smaller though similar, but the height of the strain was found to be of no importance. (3) The character circumference of head stands out first in importance in its independent contribution to yield and to a less extent the length of head. The other characters do not show consistant results from field to field. These conclusions are further confirmed by a study of the regression equations, and the value of the multiple correlations. The relation of yield to the characters, circumference of head diameter of peduncle and length of head was found to be linear. In the case of other characters the relationship was more complex. Plants with very high emergence and length of peduncle tended to produce very poor heads. (4) The causes of the relationship of yield with other characters were found to be the result to a marked extent of environmental influences as border effect, manurial response and field variation, in addition to genetic influence. These have to be borne in mind in the choice of selection of suitable types and in this connection the necessity of selecting original types from uniform unmanured fields is indicated. (*Authors' abstract*).

Studies on the nature of the causative agent of the mosaic disease of tomatoes.- S. V. Desai. (*Ind. J. Agric. Sci. 3. 626.*) A severe type of mosaic disease of tomatoes was noticd in Pusa. Many attempts made to isolate organisms from the diseased tissues by the usual methods were unsuccessful. The virus principle was obtained by crushing the tissues in tomato extract bróth and filtering through sterile L-3 filter candle after incubation for one week. The action of the virus principle was tried on various soil organisms and on organisms occurring on tomato plants to see if the virus acted as a bacteriophage. Dissolution of the organisms was not noticeable. A departure from the usual method of obtaining the culture of organisms from the diseased tissues was made by placing the diseased tissue on an agar surface after throughly sterilizing the outside of the tissue and incubating for long time. A growth from the stems of the tomato plants suffering from mosaic was obtained by this technique. The same type of growth occurred in every case from the diseased tissue while tissues from healthy plants remained sterile. The growth was peculiar and contained circular clear areas resembling the plaques given by bacteriophages,

and it was presumed that the organisms were intimately associated with the virus-bacteriophage. Attempts to obtain ultra pure culture of the organisms were unsuccessful. The bacteriophage could not be eliminated from the culture by all methods tried. The action of the virus was tried on these organisms and a slight dissolution of the organisms noticed. Serial transfers were carried for enhancing the virulence of the virus-bacteriophage by inoculating a small quantity of the sterile candle filtrate of the inoculated suspensions into fresh suspensions. Artificial production of the typical symptoms of the disease was brought about by inoculating plants with suspensions of the serial transfer in which the juice of the diseased plant was diluted to 1 : 10/16, 1 : 10/12, and 1 : 10/44. This undoubtedly established that the virus either grew with or at the expense of the organisms in vitro. (*Author's abstract*).

Determination of Nitrogen in soils, II. Protective action of silica as a factor in the estimation of nitrogen by the Kjeldahl method.— A. Sreenivasan and V. Subrahmanyan (*Ind. J. Agric. Sci. 3. 646*). In continuation of the observation reported in a previous paper (Ind. J. Agric. Sci., 1932, 2, 525) the authors have observed that addition of increasing quantities of iron or aluminium oxide or laterite to the soil renders the progress of 'dry' digestion somewhat difficult, but such compounds are not directly reoponsible for the incompleteness of reaction observed in such cases. Smooth digestion as also accurate values can be obtained by adopting the 'wet' method under such conditions. The presence of titaniferous mineral or different typs of organic compounds do not appreciably affect the progress of reaction between soil and concentrated sulphuric acid. Pre-treatment with volatile organic selvents or aqueous solutions of acids, bases or salts leads to higher values being obtained than by the official 'dry' method, but the results do not show any improvement on similar treatment with water alone. Addition of hydrogen peroxide greatly hastens the progress of digestion but allowance should be made for the nitrogen present in commercial preparations of the peroxide itself. Pre-treatment with other oxidising agents does not lead to improvement on the values obtained by the 'wet' method. Grinding the soil to a fine state of division leads to higher nitrogen values being obtained than by the 'dry' method, but the figures thus obtained are always lower than those secured by 'wet' digestion. The residue lelt after 'dry' digestion was found to consist of an unattacked soil surrounded by thick coats of silica. The latter being impenetrable to concentrated sulphuric acid, the enclosed soil particles were thus found to be effectively protected against the action of acid. The protective action of silica was more marked in the cases of heavy soils than in those of light ones. Study of the machanism of formation of the protective layer showed that (a) silica was

the immediate product of reaction between hot, concentrated sulphuric acid and the aluminosilicates present in the soil, so that the protective coat was generally formed before the acid had wetted all the soil particles, (b) when soil was heated with dilute sulphuric acid as in 'wet' digestion there was no formation of silica until all the water had been driven out so that there was always sufficient time for the acid to react with all the soil particles and (c) the layer of silica formed under conditions described in (a) though resistant to the action of concentrated sulphuric acid was readily penetrated by various other fluids including dilute sulphuric acid which further caused the lumps to break up thereby exposing the enclosed soil particles to the action of the acid and thus facilitating completion of digestion. The nature of further work leading to the standardisation of a new method of estimating nitrogen in soils, manures, plant products and other materials containing siliceous constituents is indicated. (*Authors' abstract.*)

The effect of temperature on the breakage of rice during milling.— D. Rhind and U. Tin (*Ind. J. Agric. Sci.*, 3, 658) A series of milling tests were done and the percentage of brokens related to the temperature of the unpolished brown rice. Using three pure varieties positive correlations between temperature of brown rice and per cent brokens of .8609, .8674 and .5674 were obtained. The regressions of breakage on temperature could not be reliably determined from the data available but it was deemed safe to conclude that each degree centrigade rise in temperature was accompanied by at least half a per cent increase in breakage. The correlations between breakage and moisture content of the paddy were small and insignificant. The variation in moisture content was small in all tests. It is concluded that temperature control in mills is important and for accurate laboratory tests its effect cannot be neglected. *(Authors' abstract)*

The effect of frost on some crops at Pusa.— R. D. Bose (*Agriculture and Live-stock in India Volume III Part VI.. Page 555, 1933.*) The incidence of frost in the greater part of Bihar, in special, and Pusa in particular, is a rare phenomenon. A frost was observed on the 15th January 1933 and damaged a number of crops to varying extents, Early maturing types of wheat, barley, lentils, gram, field and garden peas, linseed, sweet-potatoes, etc., were damaged to some extent. Hulless types of barley and not the hulled ones showed defective fertility of the ear-heads. Oats did not seem to be affected at all. Solanaceous crops, such as tobacco, chillies, potato, egg-plants, tomato, etc., were rather badly injured. Tobacco and chillies being the two main money crops of the tract, damages to them by frost has hard hit the poor cultivators. Plants grown in dry soils were injured more severely by freezing than similar plants in wet soils. (*Author's summary.*)

Report on an enquiry into the local consumption of Kapas in the Lyallpur District in 1930-31.—P. S. Bhullar and S. A. Singh (*Agriculture and Live-stock in India Vol. III Part VI, Page 564,1933*) Only 66 per cent of families in the villages investigated keep *Kapas* for domestic consumption. Desi *Kapas* is mostly retained for home use. The total consumption of Desi cotton including lint sold by factories is 14.1 per cent. of the total production, while that of American cotton is only 0.9 per cent. Consumption of both Desi and American cotton combined form 8·7 per cent of the total production. The percentage of local consumption to total production is governed to a large extent by the area of *kapas* grown per family consuming *kapas*, because consumption per family does not vary so much from place to place as does the area sown. Sikhs use more *kapas* per family than Muhammadans, a Sikh family consuming 50 seers annually. But when expressed as a percentage of the total quantity of *kapas* produced, it works out at 8.1 in the case of Sikhs and 9-2 per cent in the case of Muhammadans, which clearly indicates that Sikhs grow a larger area of cotton per family. The local consumption of *kapas* varies directly with the time taken to reach the nearest town. (*Authors' summary*).

Crop Forecasts

WHEAT.

First wheat forecast 1933–34.

All India.—This forecast is based on reports received from provinces and States, which comprise a little over 98 per cent of the total wheat acreage in India. The returns relate to all the important wheat growing areas in India except Kashmir. The figures dealt with in this report generally relate to the area sown up to the beginning of January. The total area sown is estimated at 34,053,000 acres as against 31,831,000 acres (revised) at this time last year, showing an increase of 7 per cent. Climatic conditions at sowing time were on the whole, favourable, and the present condition of the crop is reported to be good. More rain is however, badly wanted.

Central Provinces and Berar (10.3 per cent).— The area sown is estimated at 3,654,000 acres 192, 000 acres (102,000 acres being in Feudatory States), which is 2 per cent above the corresponding estimate of last year. Sowings were made under very favourable conditions; and germination was

generally successful although some resowing was necessary in parts of eight districts on account of rain soon after sowing. The condition of the crop is at present good and prospects are promising.

Wheat in Foreign Countries.— From information specially obtained, it appears that the estimates of the wheat crop of the United States of America for 1933 are 47,500,000 acres and 527,400,000 bushels (or 14,127,000 tons), as compared with 57,200,000 acres and 744,100.000 bushels (or 19,931,000 tons), the revised estimates of the preceeding year. The area sown with winter wheat for the 1934 crop is estimated at 41,002,000 acres, against 12,692,000 acres in the preceeding season. The condition of the crop on December 1 was reported to be 74.3 per cent of the normal. The yield of the Canadian wheat crop of 1933 is estimated at 269,729.000 bushels (or 7,225,000 tons), as compared with 443,061,000 bushels (or 11,168,000 tons), the revised estimate of 1932. The exportable surplus at the end of December last is estimated at 262 million bushels (or 7 million tons). The estimates of the wheat crop of Australia for 1933-34 are 14,500,000 acres and 160 million bushels (or 4.3 million tons), showing a decrease of 5 and 25 per cent respectively as compared with the preceeding year. The first estimate of production of the wheat crop of Argentina for 1933-34 is placed at 6,680,000 tons as compared with 6,305,000 tons, the final estimate of the preceeding year. (*The Indian Trade Journal*).

LINSEED

First forecast.

All India.— The total estimated area under linseed so far reported is 2,541,000 acres (excluding the mixed crop of the United Provinces for which no estimate is at present available). Excluding Bhopal State from which report has been received for the first time this year, the present area shows an increase of one per cent as compared with the corresponding estimate of the last year.

Central Provinces and Berar (27.1 per cent).— The area sown is estimated at 1,086,000 acres (including 99,000 acres in five Feudatory States), as against 999,000 acres reported at the corresponding date of last year, or an increase of 9 per cent. Sowings were made under favourable conditions ; and germination was successful although some resowings were necessary in parts of five districts on account of inopportune rain soon after sowing. The condition of the crop is at present satisfactory and prospects are good.

Linseed in Foreign Countries.—From the latest available bulletin published by the International Institute of Agriculture, Rome, supplemented by information specially obtained by cable, it appears that the area under linseed in the United States of America for 1933 is estimated at 1.3 million acres, which is 37 per cent less than the estimated area of last year. The estimated production of the crop is placed at 6.8 million bushels (or 170,000 tons) as compared with 11·8 million bushels (or 295,000 tons) last year. The estimates for the Canadian linseed crop of 1933 are 344,000 acres and 679,000 bushels (or 17,000 tons) as compared with 454,000 acres and 2,446,000 bushels (or 61,000 tons) in 1932. In the Argentine, the area sown with linseed during 1933-34 is estimated at 7,166,000 acres which is 3 per cent less than estimate of last year. (*The Indian Trade Journal*).

COTTON.

Third forecast.

Central Provinces and Berar.—On an average of the five years ending 1931-32, the area under cotton in the Central Provinces and Berar represents about 19.4 per cent of the total area under the crop in British India.

Area.—The current year's estimated areas of 1,250,910 acres in the Central Provinces and 2,895,740 acres in Berar are in excess of the actual areas of last year by 7 and 2 per cent respectively, the total provincial increase being 4 per cent. The total estimated area is however below the five and 10 years averages by 15 and 17 per cent, respectively.

Outturn.— For the Central Provinces and Berar together the estimated outturn works out to 72.9 per cent of the normal. The estimated yield by railway blocks for the current year is as follows :—

	Bales.
Jubbulpore block	1,100
Nerbudda block	16,300
Nimar block.	75,800
Satpura block.	14,700
Nagpur block.	120,900
Chhattisgarh block.	600
Berar block.	562,300
Total	791,700

The total number of carts of kapas which arrived in the cotton markets in the Central Provinces and Berar from 1st September to 25th November 1933 amounted to 105,022 against 62,961 and 310,564 respectively during the corresponding periods of 1932-33 and 1928-29.

The prices of cleaned cotton prevailing on the 30th November 1933 at certain district headquarters situated on the Railway, *viz.*, Nimar, Wardha, Nagpur, Akola, Amraoti and Yeotmal range from 15 to 53 per cent lower than in the corresponding period of the preceeding year. (*The Central Provinces Gazette.*)

JUAR.

Central Provinces and Berar Area—The estimated area (3,986,454 acres) sown this year in the province closely corresponds to the preceeding year's actual area (3,928,208 acres) and the decennial average (3,944,238 acres) under *kharif juar*. But it falls short of the quinquennial average by 2 per cent.

Outturn—Only Saugor and Nimar report a normal outturn while in the remaining disricts it ranges from 75 to 90 per cent of the normal excepting Nagpur where it is 67.5 per cent. For the Central Provinces and Berar together, the estimated outturn works out to 80.2 per cent of the normal.

Expressed in tons, the total estimated yield amounts to 922,600 tons, which exceeds the actual yield (887,800 tons) of last year by 4 per cent and the ten years' average by 1 per cent. It however, falls short of the five years' average by 2 per cent.

Prices—The wholesale price of *juar* ruling in the principal markets of the province on the 30th November 1933 ranged from Rs. 1-9-0 to Rs. 2-8-0 per maund against Rs.2-3-0 to Rs. 3-0-0 on the corresponding date last year.

College News

We hear that the Executive Council of the Nagpur University has agreed to permit graduates in Agriculture to proceed, if they so desire, to study for the degree of LL.B. This is a further step in the direction of recognizing the B. Ag. degree in Agriculture as equivalent to the other Bachelors' degrees in Arts and Science conferred by the University.

We understand also that proposals are under consideration for the institution of a Master's degree in Agriculture. If this proposal materilises many past and present students will welcome the opportunity of getting postgraduate research work recognised by the University.

It will also be of interest to our graduates that the local Government, according to our information, has recognized the B. Ag. degree as a qualification for admission to the C. P. Subordinate Civil Service.

* * * *

The quietness and intense devotion to study that generally characterise the days preceeding the University and Promotion examinations were rudely disturbed by the rumours of plague in certain quarters of the city. The swift and stringent measures adopted by our principal saved us much of the inconvenience and dislocation of work that would have followed a temporary closing of the college at a time when the examinations were imminent. He declared a three days' holiday for a wholesale inoculation of all the inmates of the Hostel including the servants and their families. All possible steps were taken to prevent the spread of infection to the College and hostel by a thorough disinfection of the entire premises and by preventing all unnecessary communication between the hostel and the infected areas. The inoculation and the discomforts that followed have slightly disturbed our studies but we have been saved the great worry and expense of going home and coming back at short notice during a critical period.

* * * *

Mr. B. S. Rao, our lecturer in Agriculture, was deputed to Pusa for about six weeks or so for training in tobacco curing. But his visit to Pusa seems to have been planned at an evil time. Just as he was preparing to go he had an attack of malaria which delayed his departure by about a week. Within a few days of his reaching Pusa much of the tobacco crop was destroyed by frost and the opportunities for studying curing methods were correspondingly reduced. As he was planning to come back the disastrous earthquake ruined large portions of the Pusa Institute and colony. We offer our congratulations to Mr. Rao for coming back to us safe; a thirlling account of his experiences is given on another page.

* * * *

The College debating society had a flourishing career under our enthusiastic secretary Mr. M. S. Nair. Several very interesting debates were arranged. Amongst the subjects discussed the following were of special interest. "The present system of agricultural education imparted in Indian colleges is of no practical use to the Indian cultivators and needs therefore a thorough

change"; "The problem of unemployment in India can be solved only by expanding the agricultural industry"; and "The present system in our college of restricting admission to male students alone being highly undesirable should henceforth be abolished".

At the annual inter-collegiate debate held under the auspices of the Nagpur University Union Society our representatives Messrs. A. M. Chaudhary and T. P. S. Chaudhary did well although we were not able to secure a rank as we did last time.

* * * *

The second year students were out on tour to Bhandara for studying sugarcane and spent an interesting day in Mr. Pandit's farm. We take this opportunity to thank Messrs. Pandit brothers and their Manager Mr. Hardikar for their cordial hospitality and for the trouble they have taken to demonstrate to us all details connected with the cultivation of sugarcane and the manufacture of sugar.

CANE CRUSHING WITH POWER CRUSHER.*

By G. P. Mahadeokar,

Cultivator, Balaghat District.

It has generally been observed that where facilities for cane growing exist the area cannot be increased beyond a certain acreage, as this is generally regulated by the number of pairs available for crushing. A cultivator having two pairs of bullocks can easily put down sugar cane in four acres, but he does not do it because he cannot face the crushing problem with the number of pairs that he has. He has therefore to be contented with two acres only. It is however possible to overcome this difficulty by using a small power plant which has been introduced by Messrs. Kirloskar Brothers. It is capable of handling, during one season of 4 months with 100 working days, and working 9 hours per day, 22 acres of sugarcane crop yielding on an average of 50 mds. of *gul* per acre. Where the area can be increased to this acrage a co-operative effort on the part of the growers will easily enable them to increase their individual acrage. I give below actual details of working of such a plant which shows that besides enabling a cultivator to increase his area it also considerably reduces the cost of crushing and adds to his profits. The plant supplied by Messrs. Kirloskar

* This article was sent to us for publications by the Central Agricultures Agency, Nagpur. While giving publicity to it we do not undertake any responsibility for the accuracy of the Figures contained in it.

Brothers consisted of 6 B. H. P. Seffle crude oil Engine and the ordinary Karamat crusher with power attachment. The approximate cost of the plant is Rs. 1200.

4 acres of cane was crushed with this plant. The out turn was 200 mds. of *gul* or 50 mds. per acre. The plant was worked for 160 hours which represents working for 20 days at 8 hours per day, the percentage of extraction being 62%. The details of cost are given below. The wages prevalent were annas -/3/- per day for a male cooly, annas -/2/- for a female cooly and annas -/1/6/- for a boy.

Crushing charges :—	Rs.	A.	P.
Wages of a cooly 1 female cooly and a boy for 20 days ...	8	2	0
Cost of crude oil required	22	12	0
Lubriceting oil	9	10	0
Grease	1	0	0
Wages of a driver for 20 days @ Rs. 15/- p. m. ...	10	0	0
The driver could also supervise *gul* making operation.			
Depriciation 20% for a year or Rs. 240/- for 4 months for 20 days	40	0	0
Interest @ 6% Rs. 72/- for 4 months for 20 days ...	12	0	0
Total working cost ...	103	8	0

Or Rs. 26/- per acre.

If cane on the same area was crushed with Bullock power, the expenses would have been as follows :—

Two pairs working exclusively on crushing would take 80 days working for 8 or 9 hours per day.

2 pairs per day for 80 days @ annas -/8/- per pair ...	80	0	0
Wages of cooly required, 160 men, 80 female coolies and 80 boys @ annas -/3/-, -/2/- and -/1/6 respectively ...	47	8	0
Depreciation on Rs. 160/- cost of mill;	20	0	0
Interest @ 6% on above	9	9	6
Wages of supervising for 3 months @ Rs. 15/- P.M. ...	45	0	0
Total working cost ...	202	1	6

Or Rs. 50/8/- per acre.

This goes to show that Rs. 24/8/- per acre can be saved by using the said power crusher.

MY EXPERIENCES OF THE EARTHQUAKE AT PUSA.

BY B. S. RAO, L. AG.

For the past many years I had a great desire to visit Pusa in North Bihar to see the Imperial Institute of Agricultural Research. When the Imperial Economic Botanist at Pusa informed our Director of Agriculture that a special short course for training Agricultural Department officers in the method of flue curing of Cigarrette Tobacco had been arranged and invited applications from different parts of India, I considered myself fortunate to be deputed to attend the course.

I left Nagpur on the 31st of December and reached Mokama Ghat in North Bihar on the 2nd January 1934. The new Province in which I found my self was full of interest. The broad Ganges which we crossed in a small steamer appeared glorious under the morning sun. Getting into the small B. N. W. Railway I travelled to Pusa Road Station a distance of nearly 60 miles over a country which was a veritable garden. Crops of Tobacco, Chillies Potato, Sugarcane, sweet-potato Tur and Castor were to be seen every where. I could never imagine that all these crops, so thick and green, were grown entirely without irrigation. No wonder that North Bihar has been described as the garden of India. No where else is Mother earth so kind. The soil of North Bihar which is so light, deep, mellow and ever rich in moisture, is an enviable gift of Nature.

Alighting at Pusa Road I got into the motor bus which the Pusa Estate overseer had kindly sent for my conveyance. Entering the Pusa Estate I could see on either side of the drive beautiful crops of sugarcane. The well laid out level expansive fields suggested that the place was an ideal one for field experimentation.

We were nine of us who had assembled from different parts of India to undergo the Tobacco curing course. They used to call us the "*Navagraha*" or the collection of nine Planets. We in turn promised prosperity to one and all there during our stay at Pusa. But things were destined to be otherwise.

We settled down to work and spent a couple of weeks studying the Tobacco curing process. One Sunday we visited Muzzafarpore. The Town struck us as a well constructed and neatly kept town. But our eyes met two pathetic sights frequently at Muzzafarpore, one was that a large number of persons had developed certain swellings round their necks. The second was that many were lame and incapable of any physical exertion. The swellings round

the neck were due to 'Goitre' a disease which the people developed by drinking the water of the Gandak River, which it is believed contains the Goitre producing germs. Lameness was due to the people eating unknowingly along with the pulses, the seed of a certain weed known as *acta*. Till recently it was believed that the pulses themselves produced the lameness. But recent researches have shown that the mischief is due to seeds of *acta* which along with the harvested pulse crops finds its way to the threshing floor and into the pulse which is consumed.

On the 13th of January there was a severe hail storm which completely ruined the Tobacco crop. The crop lay as if hacked to death. As we had gone to Pusa to learn Tobacco curing and as the crop was killed we were told that our course would terminate by the end of January.

Now we come to the 15th of January the day of the earth quake, the day on which people realised within a few minutes how impertinent man is to boast that he has conquered Nature. Graphic accounts of the earth quake at different places have been published in various news papers. But what we felt at Pusa and what one who had seen Pusa before will now find after the earth quake will be of interest. So I have undertaken to relate in this article my experiences of the earth quake at Pusa.

On the morning of the 15th instant I went round the Institute Building, (a building which cost 30 lakhs of rupees, I am told) to reconnoitre spots from which I could take photographs of the institute. I went to the Photographers' dark room at 2 p. m. and kept everything ready. At 2. 15 p. m. I was between the Institute building and the Central office, riding a bicycle which I had hired the very morning. I experienced a sudden jolting without the fine road being responsible for it in any way. I thought the bicycle saddle had extra sensitive springs and congratulated myself on having secured a very comfortable machine. After a few seconds there was a sound resembling the flight of a swarm of Honey Bees in the vicinity, a sound which I was familiar with in the Victoria Technical Institute building at Nagpur. We had nuisances in the past when some mischievous boys disturbed the bees by pelting the hives with stones, with serious consequences. A few seconds latar I saw people rushing out of the Central office with hands over their heads as if trying to protect themselves from being stung by bees. This strengthened my idea that bees were in the neighbourhood. So I began to peddle faster to get away from the locality. In the meantime there was a great fluttering of the glass windows of the Central office. The glass windows were all closed but the sound was there. This confused me. I did not get down from my bicycle as all the while

excepting the pleasant jolting, I did not experience any difficulty in negotiating my bicycle, A few seconds later a few of my friends who had emerged from the Central office and were by the roadside asked me to get down and not to proceed further. I obeyed, concluding that there must be honey bees beyond. As soon as I got down from my bicycle I found that I could not stand straight. I fell down and went rolling on the ground. I tried to stand up again and fell on the other side. By this time there was a terrible noise underground resembling the flight of an aeroplane. When I stood up I was tottering. I looked round. A terrible sight presented itself. The gigantic Institute Building was shaking violently. I could see the huge domes swing from side to side. This sight awakened me to a consciousness that the earth was quaking. I cannot express my state of fear thereafter. I was on the road under the huge teak trees which form the avenue. Suddenly the idea struck me that it was very unsafe to be under the trees as they might fall down and crush me to death. So I took to my heels in the direction of the lawns. But before I had run 3 or 4 yards there was a sudden explosive sound and I felt as if some one was pulling my legs from below. I felt as if I were being carried down an electric lift. I looked down and was stupefied to find that the soil on which I was standing was going down and I was knee deep in a big crack. Warm water and sand were flowing out of the crack. As I had by this time realised that the earth was quaking, the idea entered into my head that the river Gandak which surrounds the Pusa estate must have been drawn in due to the disturbance in the soil. The terrible idea that I was being drawn into the river Gandak made my blood run cold. I thought I was doomed and that fate had taken me to Pusa under the pretence of imparting knowledge regarding Tobacco curring. I believe in God and often pray to Him. You can imagine with what earnestness I must have prayed to Him when I found myself in that predicament. His helping hand did come to my aid. A thick root of the teak tree was running across the crack. I caught hold of the root and jumped out of the crack on to the hard land and stood again on the road. It was foolish on my part to have tried to get away from trees. Later on I learnt that trees are not affected by the earth quake. In fact there is less danger of fissures forming near trees than in a maidan. Having got out of the crack I stood trembling on the road not knowing what to do. The institute building was still shaking but was, as it were, refusing to fall to pieces. Had it not been for the fact that the building was a very strong one, built with excellent care by the Engineers who were in charge of its construction, I am sure most of the persons who were inside it, particularly those on the top floor, would not have been alive today. There was terrible confusion. The Institute building which so far protested against Nature and gave an opportunity for those who were inside to

rush out could not hold on any longer. The two wings of the building began to topple down. I could clearly see from where I stood the huge pillars and iron girders coming down to the ground. It seemd as if I was in a cinema show witnessing the destruction of Rome. The soil was cracking at different places and warm water was gushing out. People were in a state of panic. The quake stopped. People ran to their homes to find out the fate of their women and children. It was very fortunate that all the women and children could run out of the houses into the open space in front of the houses. Although the buildings at Pusa have not come down roof and all as those at Muzzafarpore and other places, it is not to be supposed that the shock felt at Pusa was less intense. The buildings were strong enough not to collapse completely. But the majority of the houses are very badly damaged and unsafe to live under. In many houses portions of the roof have come down. In many the key stones of the arches in the verandahs are hanging like the sword of Democles ready to crush any one who will dare enter the premises. It is feared that during the monsoon many of these buildings may sink and fall down.

Another effect of the earth quake was that in most of the wells water shot out as if from fountains for some time and then the wells became completely filled with sand. It was difficult to get adequate supplies of water for a few days. Even after attempts were made to clear the wells of sand it was found that in many wells water could not be struck easily.

People were now very busy in erecting some sort of shelter for themselves in the open. The condemned tents of the Institute which were fortunately not disposed of found a very good use. But the temporary dwellings all told were quite inadequate for the population of the estate. The damp soil the biting cold and the nervous condition in which every one found himself was making life inside the tents and huts miserable. Although the Director and the Joint Director of the Institute were very busy going round giving all help and infusing courage the mental condition of the people can easily be imagined.

Some one who professed to know something about earth quakes made a statement that in the case of earth-quakes the danger was not completely over till four shocks which recur after intervals of 4 hours had run their course. I cannot describe the fear which this put into us. Now we were not afraid of being crushed to death under the buildings. We were now open air creatures. But what about cracks and the river Gandak? Fortunately for us, though the expected shocks did recur, they were very mild and did not cause any damage, neither did the much-feared approaching '*tuphan*' materialise.

Although all of us at Pusa were by God's Grace safe none of us were free from the miserable feeling caused by the fact that we could not hear from our kith and kin in other parts of India regarding their safety. We were very eagerly expecting the arrival of some aeroplane which might have been sent to reconnoitre the affected area. Now that the post and telegraph communications were cut off we thought aeroplanes would do the needful. But no aeroplanes arrived at Pusa.

On the 20th of January it was announced that the 'Tobacco students' should go away to their respective provinces as the train service from Pusa Road to Mokama Ghat had been resumed with a transhipment between Pusa Road and Samasthipur over a bridge which was unsafe for railway traffic. I still remember how nervous we all were when we had to walk over the narrow bridge.

All along the route we could see miniature volcanic craters as it were consisting of black conical heaps of sand with a central hole through which sulphuretted water and sand had gushed out. The deposition of sand was not in very great evidence between Pusa and Mokama Ghat. But what this deposition might be like I could easily imagine from the deposition of sand to a depth of 2 to 3 inches which had taken place on some portions of the beautiful laws round the Institute building at Pusa. It is not also difficult to imagine how seriously such deposition over a vast area will affect the agriculture of the country.

As the train reached Samasthipur the first thing that attracted our attention was the Sugar factory which had collapsed. A large number of trucks filled with sugarcane were evidently waiting to be emptied. Now that the sugar factory had collapsed the cane was simply drying in the hot sun outside. What this means to the poor agriculturists of the neighbourhood who were dependent on the cane which they grow to feed the factory can be easily imagined.

We reached Barauni Junction in the evening and there was a slight shock again due to which the power house of the station failed and there was complete darkness. We reached Calcutta the following morning. I visited the museum and was surprised to find that the musium building had cracked due to the slight shock which Calcutta too had felt.

I have returned to Nagpur safe. But it will be a long time before I can overcome the terrible shock which my nerves had at Pusa during the earth quake.

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Editorial Notes

AN ECONOMIC SURVEY OF INDIA.

The two British experts, Professor Bowley and Dr. Robertson, who were invited by the Government of India to make recommendations regarding the economic organisation of the country have submitted their report, which was recently released for publication. While suggesting drastic changes in the present organisation they have recommended the establishment of a permanent economic committee with a staff of experts to tackle the economic problems of the country. Their most important recommendation relates to a census of production in the rural and urban areas at a total cost of thirty-five lakhs of rupees. Out of this total amount rupees twenty-two lakhs are required for the rural survey alone. It is obviously impossible to conduct a detailed investigation into the circumstances of each of the half-million villages in India and therefore the investigation has to be on the "sampling" method. They have recommended the appointment of seven provincial superintendents, 470 superior investigators and 1,130 assistant investigators for the purpose of carrying out the rural survey. An investigator is to stay in a selected village for a period of twelve months and record all information regarding income from land and its distribution among owners, occupiers, labourers etc., together with other items of village income.

A survey of this nature will have considerable significance from many points of view. In a country like India where 90 per cent of the people live and work in the villages a correct understanding of the broad background in which the economics of the country is set is very essential. A detailed knowledge of rural conditions is very necessary before initiating any plan of rural developments or before attempting to solve the numerous problems that beset the countryside. A comprehensive survey of the type envisaged by the learned professors will surely throw much light on our extremely complex and baffling rural problems like the relation of land-lord and tenant, debtor and creditor producer and middleman, the standard of living of the cultivators, the various factors that influence agricultural production, the problem of agricultural finance and indebtedness of the peasantry, and, the "spread" or the "differential" between the price paid by the ultimate consumer and that received by the primary producer-all these are problems, on which very little authentic data collected in a scientific manner are at present available. It is only by a first-hand study of these problems that one can say where, lies the real need of the peasantry and what items call for improvement.

On the subject of "economic planning" the Report strikes a note of caution. It is possible for Government to do as much harm by guiding production into unsuitable channels as they have done good by drawing idle resources of land labour and capital and organisation into use. Intervention in the provision of general production equipment such as irrigation works, roads and hydro-electric power is free from some of the risks of intervention in particular branches of production. The State by providing these things assumes no direct responsibility for the use that is made of them. But when they decide to direct particular branches of production they are undertaking a very grave responsibility for the solvency of millions of rural and urban

producers. This is a very serious step which should be taken only at the advice of a duly constituted council of economic experts thoroughly conversant with the conditions of production in the rural and urban areas.

EXPORT OF FRESH FRUIT.

During the last few years several attempts were made to find a foreign market for varities of Indian fruit like mangoes, and oranges. Whether successful or not from a commercial view-point these attempts have brought to light the problems involved in developing a foreign market for our surplus fruits. It would not be very difficult to find a market for some of them in Europe, particularly in Great Britain, but the chief problems are those connected with picking, ripening and transport. Fruits will have to be picked at the right stage of maturity and their ripening so controlled that they will keep their qualities for at least four weeks. For the purpose of investigating these problems the Imperial Council of Agricultural Research has recently started a Research scheme at the Ganesh-Khind Botanical Gardens at Kirkee near Poona. A cold storage plant has been installed for carrying on research work for a period of three years. The mango and the orange will be the two varieties under investgation. Intensive research will be conducted on the Alphonso, Pairi Totapuri and other mangoes to find their value for export purposes. The first attempt will be to determine the correct temperatures at which each variety has to be stored so that it will preserve its qualities. The fruit will be placed in cold storage chambers at temperatures ranging from 30 to 67 degrees F. and subsequently whithin a narrower range, 34°F. to 40°F., and will be examined at frequent intervals to study the rate of wastage. It will be placed in trays and examined at intervals to eliminate decaying ones. When the loss reaches 10 per cent the time will be noted and that will be considered as

the "commercial storage life" of the variety. The investigation is expected to include fruit from all the important fruit growing parts of India and will throw considerable light on problems like the influence of the condition of production on the commercial storage qualities of the fruits, vitamin contents and so on.

OURSELVES.

Two years ago we announced a widening of the scope of this magazine so as to make it an organ of genuine usefulness not only to the students of the College but to all who are interested in the progress of agriculture in this country. We have spared no pains to achieve this end and the very encouraging response that we have received, not only from the students of the college and the members of the Department of Agriculture, but also from the public of the province, leads us to believe that our efforts have not been in vain. We have introduced two new features in this issue. The section headed "Departmental News" will supply a long felt need of our old boys and departmental officers. The "Calendar of Operations" will help our readers to manage their gardens successfully and we hope it will make our magazine interesting to a much wider circle of readers.

Original Articles

THE PROSPECTS OF LINSEED IN THE CENTRAL PROVINCES AND BERAR

BY J. C. McDOUGALL, M.A., B.SC.

A study of the statistics relating to India's export trade in agricultural produce reveals the cheering fact that, in one commodity at least, namely linseed, a very marked improvement has taken place during the past twelve months. In the year ending March 1932, the export of linseed was 120,000 tons ; in the following year it dropped to 72,000 tons, but in the year which has just closed it jumped to 379,000 tons. Another satisfactory feature is that the tremendous increase in volume was accompanied by a slight advance in price. The present Bombay quotation for 'Bold' quality, according to the May issue of the Indian Trade Journal is Rs. 6-9-6 per cwt., as compared with Rs. 5-14 and Rs. 5-15 in May of 1933 and 1932, respectively, and prices have advanced still further since the Journal was issued.

Shipments to countries outside the United Kingdom have increased substantially, but the most noteworthy increase is in shipments to the United Kingdom and is the direct result of the Ottawa Agreement under which the United Kingdom imposed a 10 per cent duty on linseed of non-Empire origin with effect from the 1st January, 1933. The result has been that between April 1933 and March 1934, 158,000 tons of Indian linseed were imported into the United Kingdom, as against 14,000 in 1931-32 and 13,000 in 1932-33. In a single year, in fact, India has displaced the Argentine as the United Kingdom's largest supplier.

An interesting article from the pen of a London correspondent appeared recently in the 'Times of India'* in which it was suggested that the position is not so satisfactory from the point of view of the British buyer of Indian linseed as it is to India. The writer complained that the cost price of Indian seed to the British crusher was, almost consistently throughout the year, at a figure substantially higher than it ought to have been, with the result that the British manufacturer was placed at a serious disadvantage in competition with continental manufacturers. To this he attributes the fact that the United Kingdom imported only 246,000 tons of linseed in the calender year 1933, as against 362,000

* Times of India 14th April 1934.

tons in 1932, and it would seem, from a question put in the House of Commons very recently, that the same tendency is continuing during 1934. The blame for the comparatively high price he lays at the door of the Indian cultivator for having shown no sign of fulfilling the expectation of the Indian Delegation to Ottawa that an enlargement of the area under linseed in India by two million acres would not be difficult to attain within a year or two provided the preferential duty were imposed, and in support of his contention he quoted a statement by a leading authority in the British crushing trade to the effect that "there is no sign of any intention on the part of the Indian grower to produce a heavier crop to compete in the world's markets."

In view of the above remarks, some explanation for the cultivator's alleged lack of response is called for. When the Ottawa Agreement came into force on the 1st of January 1933, the crop which was due for export during 1933 had already been in the ground for three months, and consquently no expansion could be looked for during that season. The critcism therefore is evidently based on the prelimary forecast of the area sown in 1933-34 and, on that basis, there appears to be some justification for it. The second all-India forecast for 1933-34 shows no increase of the area under linseed; on the contrary there is a slight decrease in all Provinces except the Central Provinces and Hyderabad, as compared with the corresponding forecast of the previous year; and if the second forecast proves accurate the 1933-34 crop will have occupied some 30,000 acres less than the actual area, in 1932-33. Ignoring, for the moment, the effect of the character of the season at sowing time on the area sown (always a particularly important factor with regard to linseed as will be shown later) the reason for the cultivators' apparent lack of response will be readily understood by anyone with a knowledge of the difficulties associated with agricultural propaganda in India. The propagandist must be armed with something more tangible than the story of an agreement, and *that* something was lacking because the cultivators parted with their crop last year before the upward trend in prices began. Now that they have a prospect of ~~their~~ sharing the benefit of higher prices, a substantial increase in the area sown in the 1934-35 season may be anticipated with some confidence, provided conditions are favourable in September and October.

Examination of the cropping statistics of the Central Provinces and Berar during the past 25 years shows that the area put under linseed

from year to year has been characterized by extraordinarily violent fluctuations. As an extreme example of the limits of those variations, the figures for the quinquennium 1909 -10 to 1913-14 are given below :—

Year.	Jubbulpore Division Acres.	Nerbudda Division Acres.	Nagpur Division Acres.	Chhattisgarh Divn. Acres.	Berar Division Acres.	Total Acres.
1909-10	123,427	30,909	366,309	354,006	51,035	925,686
1910-11	137,799	37,525	414,074	422,771	66,445	1,078,614
1911-12	250,767	63,753	625,282	779,621	137,718	1,857,141
1912-13	259,825	72,934	508,189	569,852	98,155	1,508,955
1913-14	107,182	53,629	376,254	351,794	63,217	952,076

These figures are a forcible illustration of the unstable position of linseed—a feature which is nothing like so prominent in the other important crops of these provinces. In the case of wheat, for instance, the range of variations during the same quinquennium was between 3.06 and 3.60 million acres. For cotton it was between 4.17 and 4.75 millions; and for paddy between 4.54 and 5.00 millions. And, were we to take the figures of area under linseed in any five consecutive years we would find in most cases very striking examples of expansion and contraction. The quinquennium just finished, in which the provincial acreage varied between 738,509 and 996,823 acres, has been more stable than any quinquenium during the past 25 years.

It will be of interest to analyse the factors responsible for the variations. On the authority of the comments in the Season and Crop Reports, the factors which make for expansion are as follows :—

(*a*) favourable conditions at sowing time ;

(*b*) failure or partial failure of the *kharif* crops ;

(*c*) high prices.

Conversely, the factors which lead to contraction in area are the reverse of those just stated, namely, unfavourable conditions towards the end of the monsoon, successful *kharif* crops, and low prices.

It would appear that of the three factors just mentioned, the first is the most important. Generally speaking, conditions are favourable when the monsoon tails off gradually and finishes in time to allow sowing to be completed between the end of September and the middle of October according to locality. In the *utera* tracts where linseed is sown as a catch crop in the standing paddy and where no tillage is possible, an early and abrupt cessation of the monsoon invariably causes a serious contraction in area, except in villages fully protected by irrigation. In the tracts where the land is tilled prior to sowing, unfavourable conditions may be created by a monsoon of the type which does not provide suitable breaks for preliminary cultivation, involving hurried preparation later on and a rough seed bed, and creating a tendency in favour of substituting wheat, or gram, or of increasing the proportion of other crops where linseed is sown in mixture ; or by a monsoon which ceases early, causing the land to dry out at the normal sowing time. In the latter case the cultivator is at a loss whether to go ahead with his linseed sowing, or to sow gram, or to wait in the hope that more rain will permit him to sow wheat. Still another unfavourable type of monsoon is one which continues well into October, causing sowing to be delayed beyond the optimum time.

The success or failure of the preceeding *kharif* crop also has a considerable effect on the area available for linseed. If the conditions are very favourable in the *kharif* sowing season, the area under *kharif* will increase, leaving a correspondingly smaller area available for *rabi.* On the other hand, a heavy and continuous monsoon frequently leads to failure of the *kharif* crops on heavy soil, with the result that large areas may require to be bakhared up and put under *rabi.* In several years of heavy rainfall, failure of cotton and *juar* has led to a substantial increase in the area under linseed.

With regard to the price factor, the important consideration is not so much the actual market rate for linseed but rather the relation which that rate bears to the price of linseed's most important competitor, namely, wheat. Broadly speaking, in these provinces the cultivator normally expects to sell more than twice as much produce from an acre of wheat as from an acre of linseed. In many districts the ratio is considerably wider than that, in some others somewhat narrower. It follows, therefore, that linseed cannot enter into serious competition with wheat, in soils capable of providing a normal crop of either, unless

there is a prospect that the market rate of linseed will be approximately double or, as regards some districts, more than double the rate of wheat, bearing in mind also that of the two linseed is the more risky crop. That the risk is a real one is proved by comparison of the figures of area and outturn in 1910-11 and 1911-12. In the latter season the area increased by 70 per cent but the increase in outturn was only 16 per cent.

The remarks concerning comparative prices apply only to areas where linseed is grown as a tilled crop. They do not apply to the very considerable areas where it is grown as *utera* and where its rivals are crops which are grown more for home consumption than for sale. Provided he has received a satisfactory price for his previous crop, and provided that price has not been due to a serious failure of the previous crop, the *utera* cultivator will always take the risk of putting a large area under linseed if the seasonal conditions permit him to do so. The proportion of 'tilled' to *utera* linseed is approximately 5:2 in these provinces.

A glance at the quinquennial table on page 183 will show the phenomenal increase in the area under linseed in the season 1911-12. In that year all three factors which make for expansion were in operation together. Sowing was done under favourable conditions; part of the area which had been sown with *kharif* crops was spoilt by excessive rain and was re-cultivated and sown with *rabi*; and, in May 1911, linseed was selling at Rs. 8/11 per maund in Nagpur as compared with Rs. 2/12 per maund of wheat. The effect of a combination of unfavourable factors is illustrated by the figures for 1918-19 when the area under linseed was only 5.09 lakhs of acres as compared with 12.57 lakhs in the previous year. Conditions were adverse at sowing time, and the prices of linseed and wheat, in May 1918 were Rs. 7/10 and Rs. 5/3 respectively. An example of a year in which the seasonal and price factors pulled in opposite directions is furnished by the figures of area for 1920-21 when only 4.47 lakhs of acres were sown as compared with 9.77 lakhs in 1919-20. In that year the price factor was highly favourable for *utera* and not unfavourable for the tilled crop, linseed selling at Rs. 13/5 and wheat at Rs. 7/7 in Nagpur. Price, however, was powerless to counteract the effect of a scanty monsoon which came to an abrupt end early in September. Wheat, too, contracted in that year but to nothing like the same extent as linseed which occupied only 46 per cent of the area of the previous year, as compared with wheat's 77 per cent.

To sum up the position in the Central Provinces and Berar, the area sown with linseed has fluctuated violently in the past, and it will continue to fluctuate because the most potent controlling factor is the seasonal one. Provided that factor is favourable, the prices now current for linseed are likely to bring about a very substantial increase in the area of *utera* and, if wheat does not soon show some tendency to follow linseed out of the slough of low prices, there may also be a considerable expansion of the area under the tilled crop. The possiblities of expansion given favourable conditions, are very great, since in none of the past five years has the area touched one million acres, whereas in 1911-12 it was not far short of two millions. It is even possible that linseed may encroach on the cotton area if the present low prices of cotton continue. Again, though one cannot safely say of any crop that an increase in area will necessarily mean a corresponding increase in outturn, it would be even less safe to predict it of linseed than of most other crops.

Much improvement in the position of linseed might be brought about by intensive research. Hitherto the Department has devoted most of its attention to other more important crops, and linseed has been more or less neglected. It should be possible to substitute better-yielding types with higher oil content for those now being grown, and the evolution of a rust-resistant variety would go a long way towards eliminating the chances of failure.

COTTAGE INDUSTRIES IN THE CENTRAL PROVINCES AND BERAR

BY P. SUBBA RAO,
Department of Industries, C. P.

(*Continued from the November issue.*)

IV. SERICULTURE.

Introduction.—Silk is recognised all over the world as the aristocrat of textile fibres. Almost every country has endeavoured very earnestly for the development of its silk industry, and has established it on a sound economic footing. As an example it may be stated that Japan increased its output of silk from 51½ million lbs. in 1921 to 94 million lbs. in 1930. This is sufficient to prove that the production of silk as a commercial commodity is both profitable and necessary for the economic well being of any country.

The world's production of raw silk (published by the Silk Association of America) is given below.

1926—27	...	97.3	millions	of lbs.
1927—28	...	101.5	,,	,,
1928—29	...	107.4	,,	,,
1929—30	...	100.1	,,	,,
1930—31	...	99.0	,,	,,

There are no statistics available to show the quantity of silk produced in Asia and the above quoted output is arrived at by taking only the exports of raw silk from Asia.

China was the natural home of the silk worm, and historically speaking, other countries had secured for themselves the secret of silk worm rearing and reeling from China. At present the important silk producing countries are Japan, China, Italy, France, United States of America, India, Belgium and Russia.

India was a very important silk producing and exporting country during the latter half of the nineteenth century. But there has been a gradual decline in the production of silk from the year 1900 onwards. This can be seen from the fact that exports of raw silk decreased by 25 per cent between 1884 to 1900 and by 64 per cent from 1909 to 1914. While the imports of raw silk increased by 25 per cent and 333 per cent respectively during the same periods. Correspondingly manufactured goods of silk registered a decrease of 64 per cent in exports and an increase of 74 per cent in imports with an additional increase of 100 per cent in imports of mixed goods during the period 1909 to 1914.

During this period and later Kashmir alone stood out prominently in the whole of India and developed its silk Industry to a very great extent. Attempts to revive silk industry in other parts of India had been spasmodic with practically no results except in Mysore. The reasons for the decline of the Silk Industry in India have been many but all of them could be remedied by a systematic and organized effort and if necessary by Legislative action. It is by judicious Legislative measures and other means that Kashmir has been able to build up a stable business in silk.

That India needs an enormous quantity of silk for its consumption

is very well known and the bulk of this demand is supplied by China, Japan, Italy and Great Britain. No serious effort has yet been made to organize this industry, on an economic basis. In spite of the very serious competition from outside and several adverse local conditions sericulture still exists in India and supports several millions of people. This is in itself a sufficient guarantee that the production of silk has a very good future in India.

There are four kinds of silks grown in India; they are Mulberry silk, Eri Silk, Muga and Tasar.

Sericulture in the C. P.—In dealing with sericulture in the Central Provinces it must be stated at the outset that tasar alone is grown in this province. Inquiries at Nagpur, Bhandara, Burhanpur and Chanda show that 12.000 lbs. of mulberry is being annually imported into this province both from foreign and Indian sources. Since 1930 the proportion of Bengal mulberry was being gradually replaced by Kashmir silk and by the middle of 1932 imports of Bengal silk into the Central Provinces have completely ceased. Since the beginning of 1932 Chinese silk is comming into the market in greater quantities and the position at the end of 1932 is that Chinese silk is responsible for 40 per cent while other Indian provinces contribute the remaining 60 per cent. At the present moment on account of its cheapness Chinese silk is gradually gaining in popularity and the dealings in Kashmir silk are involving the merchants more and more in loss. Mulberry silk imported into the province is used by a large section of the handloom weavers. They also use large quantities of tasar, part of which is grown in the province and the rest imported. No statistics are avilable to make an accurate estimate either of the tasar grown in the province or the quantity of the same imported. The trade returns show all kinds imported silk in one lot.

According to census of 1931, the number of persons employed principally in silk spinning and weaving is 3,962 in the Central Provinces and Berar and 81 persons in the Central Provinces States. This figure is much less than the actual number engaged in this industry. This is due to the fact that to a large section of the people engaged in rearing tasar it is only a part time activity and they are essentially agriculturists or agricultural labourers. The reelers are generally the womenfolk of cotton and silk weavers. The weaving of silk is also a parttime business to weavers in certain districts; for example all those who

weave silk-bordered fabrics use imported mulberry silk and the weaving of this fabric is still holding the field. Only about 3,000 weavers are said to deal exclusively in silk. Therefore the number of persons interested in the silk industry in general will be several times the number indicated by the census. The number of weavers using mulberry silk for borders of *sarees* and *dhotics* is approximately 12,000. The number engaged in tasar rearing as a subsidiary occupation will be between 4,000 and 5,000 while tasar reelers and weavers may be put down as 2,000 and 1,200 respectively. The rearers work for a period of nearly 6 to 8 weeks during the whole year and raise three crops in July, October and January, of which the first 2 crops are used for seed purposes while the last one is sold to merchants. The average earnings of a rearer can be put down at about Rs. 20/-per year. Tasar weavers earn as much as Rs.1/8/-to Rs.2/-per day during the season from February to June and during the remaining seven months of the year they get between As. /8/- to As. -/12/- per day.

The organisation of the Industry.—Tasar rearing is done by *dhimars* in Bhandara, Chanda, Balaghat, Seoni and Bilaspur. Owing to the strict reservation of forests rearing is not carried out extensively in Government forests but in jungles owned by malguzars. Tasar rearing is done in these forests on payment of a rent of Re. 1/- for a crop obtained from 100 seed cacoons. Payment of rent in advance is insisted upon. This is a great hardship to the rearers as the yield of cacoons is uncertain and may entirely or partly fail owing to sudden showers of rains, storms or continued dry heat and several other unforeseen causes. The rearers practise tasar rearing as it brings in certain cash income and they have the necessary skill and knowledge for this work. Tasar cacoon merchants are a distinct set of middlemen who purchase cacoons from rearers' houses and sell them to weavers after steaming the same. Cacoons are purchased and sold by the number. The difference bewteen the purchase and sale price constitute the profit of the cacoon dealer who invests money and takes pains to visit the rearers' houses for collecting cacoons and bringing them to the weavers. The rearer does not usually keep back any seed cacoons from the January crop but depends upon the chances of collecting wild seed cacoons in June. The cacoon dealer to be sure of a ready supply, advances money while the worms are feeding on trees. The malguzars are usually very reluctant to let the rearer use the Jungle, as pollarding of trees is believed to be injurious to a good growth of timber which he values more than the rent from the cacoon rearer. These difficulties stand in the way of expansion of the industry. There

is no organisation either for sale or purchase of cacoons. But generally each cacoon dealer buys from a particular locality only, and he rarely goes out of that area. The weavers would be idle without a regular supply of tasar yarn and so they also purchase the raw material from Mayurbhanj State, Chaibasa and Sambalpur. Some dealers usually go for cacoons to the adjacent districts and bring in their material booked as luggage in passenger trains. The bulk of cacoons imported by dealers in this way is not shown in the railborne trade returns. The tasar cloth woven in the province is consumed locally. It is not used for household consumption by the weavers.

The rearing of tasar.—Tasar worms feed on *Asan* trees locally known as *Yen* in this province. The seed cacoons are collected from thick jungles where wild moths lay eggs. These eggs hatch in due course and the worms feed and grow and finally spin cacoons. These cocoons are collected for purposes of seed with some difficulty by rearers. They are brought to their houses and kept tied to bamboo rafters in the roof till moths emerge. The moths are collected and paired off in a net bag for pretection against birds and lizards. After one night's pairing, the male moth is separated and allowed to fly away while the female moths are kept in a bamboo basket for another day for laying eggs. The female moth dies while laying eggs in the basket. The dead moths are thrown away and the eggs are collected and kept in a dry leaf carefully folded and covered. Each female moth lays 80 to 100 eggs. This is done in the month of June and the eggs remain for a period of one week in that condition and hatch on the 8th day. As soon as they hatch the worms are taken to the jungle and allowed to feed on tender leaves of the *Asan* trees. Trees not higher than 10 feet are selected for this purpose so that the reareer may transfer from one tree to the other when necessary for supply of fresh food. This transferring from an empty tree to one with better foilage is done by cutting of branches from the first trees and tying them to the latter. The rearers in some cases where the jungle is very thin protect the young worms by constant watch and shade the trees by hanging branches all round. This is done both by men and women. These worms feed on the trees for a period of four to six weeks. There is usually a large percentage of death due to excessive rain or disease but the few that survive spin cacoons which will be completed by the end of October when the cocoons are gathered and brought in to the rearers' house. The cacoons must be preserved for a period of 20 days for the months to come out. The eggs are then collected and allowed

to hatch. The worms are taken to the jungle and allowed to grow there and the cacoons are collected in January. Beginning with a few wild cacoons in June, the rearer takes them through the second crop to multiply his seed supply and gets a large crop of cacoons in January for sale. The cacoons produced in January do not bring out moths till about June. The rearer sells them and depends on the chance of collecting seed cacoons from the jungle, mostly those that escaped him in January. In some cases rearers keep back a few cacoons and grow seed out of them for June. This practice of growing one's own seed is not practised in this province as the rearers are not sure of renting a suitable jungle nor can they count on all the cacoons giving healthy male and female moths. In some cases a rearer purchases seed cacoons at 25 per rupee in July from other rearers who may have gathered more, and in November also seed cacoons are purchased by some rearers at the rate of 100 cacoons or a few more per rupee.

The sale rate of cacoons in January depends on the size of the crop. The dealers who are middlemen, usually take advantage of the poverty of the rearers and try to by the cacoons from them as cheap as possible. This is responsible to some extent for the gradual decline of the tasar industry in this province. The difference between the purchrse and the sale rate of cacoons is about 50 per cent and the rearer who has laboured and waited for six months hardly gets an adequate remuneration.

In the cost of producing cacoons there are only two items—the rent paid to the malguzar for using the jungle and the cost of labour of the rearer and his family. Rent paid to the malguzar is Rs. 10/- to Rs. 12/ per annum at Re. 1/- per 100 seed cacoons and rearer's wages are the cost realised for the cacoons sold less Rs. 10/-. The rearer does not work unless he has at least 5000 seed cacoons. He produces on an average 4,000 cacoons for which he gets Rs. 20/- at the present market rate. He pays Rs. 10/- as rent and Rs. 10/- represents his earnings for 60 days' labour. As he does some other kind of work during these days he finds this income sufficiently attractive to continue in this. Woman and children go out to the jungle to collect fuel for sale and attend to collection or watching of tasar worms feeding on trees. During the period when rearing is being done the rearers attend to this work for practically the whole day.

Reeling and weaving.—Silk reeling is generally done by hand by the weavers' women excepting about 20 families of weavers at Bhandara

who employ special reelers by paying them at the rates of As. 2 per day. No machines are employed. The waste produced at Bhandara is sold to merchants at As. -/4/- per seer for export to Calcutta while in other places it is spun into coarse thread and woven into cloth for local sale. *Kahan* is the unit for the purchase and sale of tasar cacoons. A *kahan* in the Central Provinces is ordinarily 25 x 80 cacoons. A *kahan* of cacoons produces nearly 2 lbs. of raw tasar and 2 lbs. of waste. About 90,000 *kahans* of cacoons are reaised in the Central Provinces annually, producing 2,200 maunds of raw silk and an equal quantity of waste. At the present market rates tasar silk yarn is sold for Rs. 16/- per seer and waste at As. -/4/- per seer. The value of tasar silk produced in the province is in the neighbourhood of 14 lakhs of rupees and Rs. 22,000 worth of waste. Excepting for a very small quantity the whole of the waste produced is used in the province.

The handloom weavers of the province use nearly 1, 000 maunds of imported mulberry and 4, 000 maunds of imported tasar in addition to 2, 000 maunds of locally produced tasar. Mulberry silk imported from Kashmir is sold in the local market at Rs. 7/10/- a lb. compared with Rs. 4/6/- a lb. of Chinese silk. Kashmir silk is much superior to Chinese material in respect of its evenness and freedom from entanglements. To open out a seer of Chinese silk it takes as much as 6 days, while a seer of Kashmir silk could be opened in a day. This factor puts up the cost of Chinese silk by nearly Re. 1/- a seer. But as the Chinese silk is cheaper than the Kashmir material by Rs. 6/8/- a seer, the weaver gains by Rs. 3/8/- per seer. The quality of the cloth made out of Chinese silk is much inferior and involves more labour in weaving and other operations which is also a factor adding to the cost of raw material. The weaver purchases the cheaper Chinese material because he has to invest less cash on its purchase. The popularity of silk cloths will be adversely affected as the quality is very poor. It is certainly a distinct disadvantage to the bulk of silk weavers, if as a result of the use of cheap Chinese mulberry they are to lose the demand for this special class of silk-bordered fabrics. When a cheap and distinctly inferior silk is imported in great quantities, the demand for other silks is reduced resulting in a loss to merchants and weavers as above explained.

Local tasar industry is on a small scale and it is not yet affected by the Chinese imports as the tasar workers do not use mulberry silk which is the kind of silk imported from China. There is practically no

competition from the modern industry in tasar silk. The other reasons for the decline of the once flourishing tasar industry are purely natural. The tasar silk worms are subject to diseases the prevention of which has not yet been undertaken.

Improvements.— Efforts are being made to improve the weaving of tasar cloth by the introduction of improved appliances. Dyeing of tasar silk in fast colours is also taught to the weavers in place of fugitive colours and this has improved the sale of tasar cloth. By the use of flyshuttle sleys the weavers are now able to produce more than before and earn more thereby. Imports of tasar silk into the province are increasing while the production of local cacoons is not correspondingly increasing. The weavers prefer to use imported cacoons from Bihar and Orissa as those are bigger and contain more silk. Certain amount of propaganda among the rearers and weavers resulted in a partial awakening among those people. Whatever efforts have to be made must be made by the Government and the present financial stringency has been a great set back for any steps being taken to improve this industry. There are no private organisations working for the development of this industry but the few individual traders work for their own profit rather than for bettering the condition of the workers.

There is ample scope for the improvement and expansion of the Tasar industry in this province. The method of rearing the Tasar worm is capable of considerable improvement. A model farm for the demonstration of Tasar rearing may be established in the Centre of the industry. A central Agency is required for collecting and marketing the cacoons. This will eliminate the middlemen and increase the profits of rearers. This would give an impetus to the industry.

FRUIT CULTURE.

BY B. R. PHATAK, B. Ag.

(Continued from the previous Issue.)

MANURING.

The question of manuring is one on which the grower is not likely to be influenced by the consideration of the possible exhaustion of the soil in future generations. The practical problem for his consi-

deration is whether manuring will repay him either now or within a reasonable period.

The results obtained at Ridgemouth during twenty two years led to the conclusion that the apple trees which had been dressed every year throughout that period with various dressings of artificial fertilizers and natural manures have shown no appreciable advantage over similar trees which received no dressing at all. The reverse has proved to be the case with bush fruit, such as currants, gooseberries and raspberries; those which were left unmanured have been practically exterminated, while those which were manured flourished, but the manure which was essential in these cases was bulky organic manure, such as dung, since artificial manures produced but little more effect than no manure at all. This is explained as due to the peculiar physiological behaviour of apple when compared with bush fruit. The results of investigation on poorer soil showed themselves in favour of better manuring. Investigation at Ridgemouth did not give indications of superior results with the application of nitrogen or inferiority on account of its elimination.

Investigations in United States of America go to prove the greater importance of nitrogen. Both its excess and deficiency have brought about pathological conditions in deciduous fruit trees.

Gardener and his colleagues have come to the following conclusion:-

"It is therefore evident that the question of fertilizers for deciduous fruits, in so far as such fertilizers serve more or less directly as nutrients for the plant, centres largely around the proper use of nitrogen. This is far from stating that the fertilizers other than those carrying nitrogen are never of direct nutrient value. For instance, work with grapes and strawberries suggests strongly that sulphur carrying fertilizers in the one case and the phosphorus carrying in the other supplied the plants directly with these nutrients, though it is possible that certain of their more indirect influences may have been more important than their direct ones. Furthermore there is reason to believe that many of the results obtained from the use of phosphorus, potassium and calcium carrying fertilizers on deciduous fruits of different kinds and generally attributed to their direct nutrient value, have in reality been due to their functioning in other ways. These statements are not made to minimise the possible effects or uses of fertilizing elements other than

nitrogen. That they often are of value in the orchard, there is no doubt. The point is that the nitrogenous fertilizers act more or less directly as nutrient carrying substances, others act rather indirectly through correlation of unfavourable soil conditions or by protecting orchard plants from harmful substances or only indirectly as nutrients through assisting the growth of inter-crops or cover crops. Clear differentiation between these different modes of operation is important, for only when there is a clear conception of how a fertilizer works can it be used intelligently and with certainty as to results ".

These authors have further observed, after carefully noting certain cultural and fertilizing experiments, that many orchards will not respond to nitrogenous fertilizers because the soils and the methods of soil management are of such a character that nitrogen is not a limiting factor. On the other hand experience shows that there are many orchards in which nitrogen is a limiting factor and in which consequently nitrogen forming fertilizers can be used profitably. To conclude from one experiment or a series of experiments that orchard fertilization in general is not needed or that it does not pay is as eroneous as it is to conclude from striking returns on a nitrate deficient soil that orchards generally should be regularly fertilized with that element.

Symptoms of nitrogen starvation.—Yellowish green colour of the leaves accompanied by feeble growth is often an indication of nitrogen starvation. Premature loss of leaves in the fall or failure of blossom to set fruit are other symptoms.

The necessity of fertilization can be determined by process of climination whereby more obvious troubles are first set aside. On the other hand absence of any pronounced symptoms is no proof that the trees will not respond favourably to nitrogen treatment.

According to Coit.—A study of soil analysis teaches us that when the average California soil begins to fail from heavy production nitrogen is most likely to be the limiting factor, and after nitrogen phosphoric acid, and after that potash.

The influence of nitrogenous fertilizers on shoot and leaf growth and on the formation of fruit buds is not less striking than their effect on setting fruit, especially in rather weak trees that still bloom heavily.

Influence of nitrate of soda application upon setting of fruit in apples.—

Treatment.	No. of blossoming spurs.	%age fruit set June 4	%age fruit set Sept. 30	Average yield per tree, bushels
First orchard check (Unfertilized). ...	483	35.3	16.4	3.75
Fertilized with nitrate. ...	542 .	68.0	30.7	21.50
Second orchard Check (Unfertilized). ...	386	9.0	4.6	1.33
Fertilized with nitrate. ...	620	58.0	15.1	9.50

Influence of nitrogen on size of fruit.—Since the size the fruit attains is an expression of the plant's vegetative activity it may be supposed that the factors of treatments leading to an increased shoot and leaf development may likewise lead to increased size of fruit.

Size of apples as influenced by nitrate application.

Treatment.	Precent grading.		
	175 to 150 per bushel	138 to 112 per bushel	100 per bushel and
Check (no fertilizer)	22.09	39.06	38.15
Nitrate of soda	2.28	26.91	70.76

The nitrate thus shows an all round influence of fruit trees.

Pound of nitrogen in one thousand pounds of fresh fruit.

Apples	1.05
Bananas	0.97
Figs	2.38
Lemons	1.51
Oranges	1.83
Grapes	1.26

Pounds of nitrogen in parts of a full grown tree.

	Apple.	Peach.	Pear.	Plum.	Quince.
Fruit and fruit pulp ...	0.57	0.12	0.08	0.08	0.09
Stones	...	0.03	...	0.02	...
Stems	...	...	...	0.01	...
Leaves	0.87	0.52	0.15	0.12	0.09
New growth	0.03	0.05	0.02	0.02	0.01

In a thirty year old tree two thirds as much nitrogen goes into the crop as falls within the leaf and the amount used for new growth is insignificant in comparison.

Pounds of phosphorus of a full grown tree.

Fruit and Pulp	0.105	0.026	0.013	0.013	0.017
Stones	...	0.004	...	0.004	...
Leaves	0.061	0.031	0.008	0.008	0.004
New growth	0.004	0.004	0.004	0.004	0.004

Only 1/10th to 1/5th as much phosphorus as nitrogen is left in the leaf, but the fruit contains 1/5 lb. of phosphorus in one thousand of fresh fruit.

Pounds of Phosphorus in 1000 lbs of fresh fruit.

Apples	0.14
Bananas	0.07
Figs	0.38
Grapes	0.05
Lemons	0.25
Oranges	0.23

Pounds of Potash in 1000 lbs of fresh fruit.

Apples	1.40
Bananas	6.80
Figs	4.69
Grapes	2.55
Lemons	2.54
Oranges	2.11

In deciding the quantity of manure to be applied, the food material

found in leaves, which are dropped and incorporated with the soil need not be taken into account. New growth made by plants contains only insignificant quantities of these food ingredients, and the manure added is thus really to replace what is removed through the fruit which is carried away from the land. Taking the case of the orange, an orange tree bearing a crop of 2000 fruit roughly weighing 400 lbs. this will removed from the soil 0·732 lb. nitrogen 0.14 lb. Phosphoric acid and 0·9 lb potash. These food ingredients are easily contained, roughly, in 100 lbs of cattle dung and so far as nitrogen is concerned in 15 lbs. of til cake.

The experimental dressings per tree applied in the orange garden Nagpur are given below.

The dressings are:—

(1) cattle dung 75 lbs + cake 21 lbs. + am. sulphate 2 lbs.
(2) cake 10.5 lbs. + cake 10.5 lbs. + am. sulph. 2 lbs. + Super 7 lbs.
(3) cattle dung 75 lbs. + cattle dung 75 lbs. + am. Sulph. 2 lbs.
(4) Cake 10.5 lbs. per dose given three times.
(5) cattle dung 75 lbs. per dose three times.

Californian dressing quoted by Coit supplies 1.7 lbs. nitrogen in the course of the year. The actual dressing consists 7 lbs. bone meal 2 lbs. sulphate of ammonia, 12 lbs. tankage, 5 cwt. stable manure, while the manures given above supply 1.8 lb of nitrogen.

Setting of fruit.—It is not to be expected that all the blossoms will set fruit, even though the conditions are ideal. In most varieties and species they are produced in such profusion, that a total set will be a little short of calamitous for the grower. He is more interested in obtaining a reasonable number of specimens of good marketable size than a much larger number of specimens of a size for which there is little demand. Furthermore he prefers a crop such as the trees can mature without undue exhaustion, for then he is surer of crops in the following years.

All of the flowers that fail to mature fruit do not drop at one time and continuous dropping from the flowering stage to maturity is not common. Instead there are more or less definite periods or stages when dropping occurs. The loss comes in a series of waves varying in different fruit in number and in the length of time between them. There appears to be certain sticking points-critical periods-through which each fruit must proceed to reach full maturity.

In the Nagpur oranges for the *ambia bahar* the fruit drops, when still small in the months of April and May probably due to imperfect fertilization or to undue dryness of the weather. Fruit may drop also due to severe cutting of the roots in cultivation. The fruit of this, as well as the *mrig bahar*, also drops to a certain extent just after the rains start. There is another drop occuring some time in september particularly on undrained soils and where weed is heavy. At this time a moth is found to puncture the fruit and there is a certain drop due to the same. There are heavy winds often blowing and bringing with them a large fall in the fruit. The very serious drop is immediately after the formation of small fruit.

Fruit setting of the same variety is often much better in one locality than in another. It might be possible to segregate the various factors of soil temperature, humidity, light, etc that constitute what is termed locality and to assign to each its portion of total influence on fruit setting. Seasonal variations are closely associated with the local influence in this respect. Blossom appearing towards the end of a particular season allows more fruit to set. Season occasionally produces occasional effects on fruit setting by complete suppression of one or the other of the two organs. Young, vigorous trees often fail to set fruit under uncontrolled cross pollination when older and less vigorous trees set freely. The influence of temperature may be more directly upon the formation of the flower buds than upon the process of fruit setting. High temperature conditions of low atmospheric humidity, exposure to high winds and limited supply of soil moisture, some times induce in trees moisture deficits that lead to the formation of abscission layer and the dropping of the blossom or fruit. Too much water in the soil may have quite the same effect as too little and suitable drainage is thereby indicated as surely as irrigation. Rain at blossoming is recognized generally as one of the most important factors limiting the set of fruit. Experimental evidence of the damaging influence of rain on fruit setting is furnished by an experiment in which a Mount Vernon pear tree was sprayed continuously for 219 hours while in bloom. This tree set very little fruit while a tree of the same variety standing nearby and not subjected to this treatment set a good crop. Similar results were obtained with two Duchess Grape vines. Much of the effects of rains is possibly due to the lower temperature associated with it and the arrest of the movements of bees responsible for pollination.

The Majority of decidious fruit are insect-pollinated. With these

the wind hinders rather than helps pollination, since bees and other pollen-carrying insects work most effectively in still atmosphere, and in a strong wind refuse to work at all. There will be much better set of fruit where the trees are protected from the full sweep of the wind and in exposed places there is often a much better set on the leeward than on the wind-ward side of the trees. Wind may act more directly by whipping about the flowers and causing mechanical injuries; it may also cause the stigmatic fluid to dry prematurely and thus prevent the germination of the pollen grain.

Fruit plants do not bear equally every year. There is more or less a certain cycle in them of good, intermediate and bad years. Various kinds of climatic interference often interrupt this cycle. Some fruit trees like oranges, bear fruit at three different seasons and may supply fruit practically throughout the year. It is necessary to regulate the fruit bearing in different seasons so as to maintain a regular supply for the market. This problem is however beset with various difficulties and much work is necessary before a correct solution is attained.

In mangoes, particularly, fruit setting is interfered with by thrips, and better setting results after dusting the infloresence with calcium cynide and sulphur.

It is necessary to note here one particular circumstance in Nagpur oranges seen in the college garden. It is not related with fruit setting but with the actual death of the plant. This occurs occasionally in a tree here and a tree there in the end of the warm weather or in the beginning of the rains. A tree at this time may show a sudden wilting of the leaves as if it did not get sufficient moisture. No insect or other cause has been traced. Attempts at watering on the appearance of this symptom have been of no avail in keeping this tree alive. The surrounding trees look quite healthy and live with out any apparent signs of disease thereafter. The particular tree however dies. These have died in different part of the garden in different years, not in immediate proximity to where one had previously died.

Orchard soil management.—Most of our fruit trees have the soil under them well and cleanly cultivated; there is hardly any weed existing. Mango groves, however, are often full of grass. The effect of this grass on the land has been very much investigated in England where apple orchards were found to suffer from its effects. The whole orchard that

was under grass delleriorates completely. This effect of grass was known to rise neither from deficient nutrition nor from deficient water supply nor even from bad aeration. Artificial irrigation to make up water deficiency, and additional food supply to counteract the deficiency in that direction, did not make good all loss resulting from the undersod. So far from the action of the grass on trees being explicable on the ground that it impoverishes the soil, it, as a matter of fact, enriches it. This has been actually established now for many years, and experiments at Woburn have demonstrated that soil in which grass has been growing for ten or twelve years is actually much more suitable to the growth of trees than soil in its vicinity which had been kept tilled. The vigour of the trees grown in it when grass was removed was more than double that of the trees in the tilled ground, where as in this same soil when the turf was replaced over the roots of the trees the vigour of the latter was only half of that on the poorer ungrassed soil. In the pot experiments it was found that after the experiment was concluded the soil left in the pots containing the trees with grass over them was actually richer in nitrogenous matter to the extent of about 40 percent than in pots without grass (soil originally taken being the same) though the trees were dying in the former case and flourishing in the latter. It was therefore concluded that this effect was due to some toxic influence interfering with the physiological action of the plant and preventing it from utilising the food which was present.

The toxic effect is of a temporary character and does not accummulate in the soil at all. It is while the surface crop is actually growing that the trees are affected by it, and so long as the trees have not become hidebound and shrunken beyond recall it is only necessary to remove the surface growth in order to restore it to vigour. Weeds have less effect than grass. The greater the depth of soil and the more efficient the drainage, the less the effects of grass.

Mango groves are usually on deep soils and some times with less rainfall. Their roots therefore penetrate deep and the toxic effect of the grass is not much felt. Even then clean ground will grow better mango trees than ground covered with grass.

In the United States of America orchard soil is managed in various ways. They are divided into six classes (1) clean cultivation, (2) clean culture, with cover crop, (3) artificial mulch, (4) sod mulch, (5) sod, (6) inter-cropping. Sod and sod-mulch systems are more effective in

reducing run off, and in preventing erosion. In certain situations their use is to be recommended for this reason if for no other. The various systems of soil management employing tillage generally conserve a larger percentage of the water that enters the soil and consequently they are more effective in preventing injury from drought. The sod-mulch method has its place where abundant summer rainfall, deep rooting, or availability of irrigation water largely remove the trees from the need of surface culture for water. The moisture-conserving effects of tillage increase somewhat with its frequency and depth, but when the cost is considered there is a decreasing margin of profit with the deeper and more frequent cultivation. Cultivated inter crops may be used safely, but the small grains are apt to make too serious a draft on moisture at periods when the trees should be abundantly supplied. Cover crops consume considerable moisture but unless planted too early they are not likely to injure the trees seriously by their growth. Indeed, in the rains, in a locality like Nagpur they are very apt to improve the growth by withdrawing surplus water.

Injury by cold and frost.—In relation to soil moisture, Emerson made some interesting studies on the effect of moisture on the killing of roots in moist, cold conditions, in which he exposed lots of 25 seedlings to the Nebraska winter in boxes of loam with varying soil moisture.

Root killing of apples seedlings as related to soil moisture.

Box	Where kept.	Soil cover.	Percent soil moisture.	Number injured		
				Uninjured.	Injured.	Dead.
1	Outdoors	none	10.4	0	5	20
2	do.	do.	15.2	9	6	10
3	do.	do.	19.8	12	10	3
4	do.	do.	25.6	13	4	8
5	do.	strawmulch	16.0	15	7	0
6	do.	none	15.8	10	8	7
7	cool dry case.	do.	10.0	25	0	0

The table above shows the protective effect of an artificial mulch, of non-exposure to open air (unattainable in the field), and of percentage of moisture, in increasing percentage of the last named which acts by preventing the soil from frequently freezing and thawing. The mulch also acted by preventing freezing over-night and also frequent freezing and thawing.

Preventive measures include moderately deep planting, choice of locations not unduly exposed to winds, the use of cover croys and artificial mulching. Remedial treatment consists in judicious pruning.

Frost.—Some localities in the C.P. are either annually or occasionally visited by frost. Conditions favouring loss of heat by radiation and a calm condition of the air combine to produce dew or frost clouds reflect the heat lost by radiation and even radiate some of their own heat, so that the passage of a cloud may for a short time raise the temperature. Cloudy nights, though still, are not on that account very unlikely to be frosty. A fair breeze does not prevent radiation but it mixes the air and prevents excessive cooling of any small portion of it; windy nights are not therefore likely to be frosty. It is the nights which combine good radiation conditions with still air that the fruit grower should watch as he should then expect frost.

Careful records should be maintained of when frosts occurred in different years, and precautionary measures resorted to if the conditions mentioned above occur near about these dates. The dates are not always the same but the records would be useful. If the soil is more moist dew forms and the release of heat thereby may prevent the lowering of temperature and may thus not permit frosts to form. When the dew point is not very low freezing will occur without frost formation.

Fighting Frost.—Dense smoke might retard radiation and check frost damage to a small extent. The difference in temperature produced by smudging is however very small. Orchard heating is also rather expensive. Published results of careful experiments indicate that the actual heating rarely exceeds 5 degrees and that 4 degrees is a liberal estimate. Under Indian conditions this might be of material use but the cost would be prohibitive.

Plants in vigorous condition are no more resistant to frost but they possess recuperative power.

SUGARCANE IN BIHAR.

By H. Misra. B. Ag.

Introduction.—It is said that India is the original home of sugarcane and that sugar industry existed in this country from time immemorial. Inspite of a vast area under cane, amounting to about three million acres which is the second largest area in the world, India has been importing increasing amounts of sugar every year the import figure rising to 901, 200 tons in 1930-'31. To check this heavy import and to give a substantial impetus to the development of a home industry, a protective duty of Rs. 9-1-0 per cwt or Rs. 6-10-6 per md. was levied in September 1931 on all imported sugar. The imposition of this heavy duty is itself the most potent single factor in effecting an expansion of this industry. It is hoped that this expansion will be on a sound and lasting basis on account of the present period of economic depression which has brought the price of land, machinery and cane very low. Moreover sugar-cane still fetches a fair remuneration to the grower in spite of the low prices and hence a large area is cultivated under this crop in Bihar, thus ensuring an adequate supply of cane to the manufacturer of sugar. Of the three million acres of cane land in India the United Provinces of Agra and Oudh contribute 1.6 million acres, the Punjab 0.49 million acres, Bihar and Orrisa 0.29 million acres, Madras 0.29 million acres and the rest is contributed by other provinces. Though the provinces of Bihar and Orissa ranks third in importance, the position of Bihar proper is probably as important as or even more than that of the United Provinces on account of the fact that about 95 percent of the area under cane in this province is concentrated in the Bihar alone.

Extent of cane cultivation in Bihar.—Sugarcane is essentially a tropical plant requiring high temperature and rainfall. In India wherever these conditions are favourable the yield of cane is high. In Bihar the temperature is high but the rainfall is low. For this reason the yield of cane is low is this region. A high yield of cane in obtained in Sind, Bombay and Madras. In these tracts the yield is above 6,000 lbs. of *gur* per acre. In Mysore, Central Provinces and Bengal the yield is above 3,000 lbs. of *gur* but not exceeding 4,000 lbs. In the United provinces Assam, Bihar and Orissa and Delhi the yield is between 2,000 and 3,000 lbs. of *gur*. The other cane growing tracts of India such

as the Punjab and the north-West Frontier have a yield which is below 2,000 lbs. of *gur*. The figure for Bihar and Orissa is representative of North Bihar which has the largest area under cane in the province. In this region the rainfall is not very high but even so the cane is grown without irrigation. The normal harvest of cane in North Bihar is about 400 mds. With irrigation the harvest reaches as high as 720 mds. In South Bihar and East Bihar cane is grown with irrigation and the normal yield ranges from 500 mds. to 800 mds. of cane.

At present sugarcane is grown in all the districts of Bihar. The following table shows the distribution of the area under cane in the different districts of Bihar.

	District.	Cultivated area (acres)	Area under cane in 1931-32	Percentage of cane area to cultivated area.
South Bihar	Patna	1,078.100	10,700	1.55
	Gaya	2,118,100	32,900	1.55
	Shahabad	1,762,500	38,000	2.15
North Bihar	Saran	1,357,200	59,400	4.38
	Champaran	1,430,200	21,100	1.476
	Muzaffarpur	1,627,000	22,100	1.36
	Darbhanga	1,677,800	19,400	1.16
East Bihar	Monghyr	1,586,800	7,900	0.498
	Bhagalpur	1,684,100	12,900	0.766
	Purnea	1,694,400	9,500	0.561
	Santal parganas	1,717,900	6,500	0.369

The establishment of a number of sugar factories in North Bihar in rapid succession has saturated the atmosphere of Bihar with the talk of sugar. Sooner or later there will be a demand for the extension of cane production in Bihar. The amount of virgin land available is negligible in both North and South Bihar. Some land is still available in the districts of Gaya and Shahabad and a good deal in East Bihar. But owing to lack of facilities of communication these lands are not readily utilisable for the development of the sugar industry. If it is desired to extend the area under sugarcane by displacing some of the crops now being grown, there is some hope. The present money value of sugarcane is however not so tempting as to make the cultivator grow

sugarcane in place of food grains which may result in an acute economic distress by raising the price of food grains. Bihar has a large area under oil seeds but the present movement favouring Indian oil seeds in the English market promises an advantage for Bihar in this direction and therefore oil seeds stand as an enemy to the extension of the cane area in Bihar. That fibre has not the same economic importance now as before is evidenced by its ready displacement by cane in some districts with the proposal to open new factories there. A possible displacement of 25 per cent of the present area under fibre by cane will not be too optimistic so as to bring the two crops to a point of economic balance. The indigo industry of Bihar died in 1926, but official estimates do not confirm the popular belief that sugarcane has taken its place. A considerable increase in area under millets is noticed since 1926. There is also a vast area under 'drugs and narcotics'. It is therefore possible to divert a good amount of land for sugarcane. The total of all these displacements will come to 140,000 thousand acres which is nearly 50 per cent of the present area under cane. Except in North Bihar sugarcane is grown under irrigation. At present only 1.5 to 5 per cent of the irrigated area is occupied by sugarcane. Most of the irrigated area is under food grains and some water is still used for growing non-food crops other than sugarcane. From this it may be concluded that it is not very difficult to find a way for the irrigation of the new cane area.

Methods of cultivation.—The continued prosperity of the white sugar industry depends upon the quality of sugarcane. Some sixteen years ago the white sugar industry of Bihar was in a precarious condition as the local canes had badly deteriorated. The Agriculture Department of Bihar has successfully displaced the indigenous varieties by the improved Coimbatore varieties such as CO 213, CO 210, CO 214 and CO 205. The introductin of these varieties has beyond doubt effected a higher yield to the advantage of the cultivator and the mill. Recently a cane research station for the province has been established at Mushari in North Bihar. Manurial and varietal experiments of much importance are being carried on at the Sepaya Government Farm in the District of Saran. A higher standard of cane production in Bihar will inevitably follow the results of all these researches.

What contributes largely to a higher standard of production is better cultivation.

There are two different methods of cane cultivation in Bihar. A brief description of these two methods is given below.

1. **The dry method.**—In this method of cultivation the land is kept fallow during the rabi season previous to cane planting. At the end of the monsoon the land is ploughed by a mould board plough. A second ploughing is given in January and the last in February. Farm yard manure whenever used is applied in December and then ploughed in. Sugarcane is generally planted during February and March but occasionally in October on lands which do not retain moisture. For the planting of cane furrows are drawn at a distance of 2½ feet apart by a ridging plough. The setts are laid in the furrows and covered up quickly by drawing earth from both sides of the furrow by means of a spade. A '*henga*' (beam harrow) is then run across the rows, this operation being considered helpful for quicker germination. Interculture begins as soon as most of the setts have germinated and is repeated every three weeks or a month throughout the hot weather. When the monsoon breaks earthing up is done by the ridging plough. This operation is done to prevent cane from lodging and to drain away surplus water. After earthing up, no more operation is done till harvesting.

2. **The irrigated method.**—In this method of cultivaion the fundamental operations are practically the same everywhere though details vary from district to district. The method described here is typical of the district of Patna. Manuring is invariably done either by sheep folding or by applying farm yard manure. To mix the manure the land is ploughed by a country plough and the operation is repeated every 10 to 15 days till the end of January. Each ploughing is followed by the working of a *henga*. After planting the land is leveled up and pressed and then irrigated in a day or two. Within three weeks of planting one more irrigation is given. Mulching or breaking up the crust follows every irrigation. The third irrigation comes a month after the second and subsequent irrigations at a month's interval. The earthing up is done in July (*Ardra Nakshatra*). After this no operation is done till January when harvesting begins.

Attempts are being made to improve the indigenous methods of cultivation wherever they are found defective. The Bihar Department of Agriculture gives valuable suggestions to the cane growers for the better cultivation of cane. Of those only the most important ones are

mentioned here. In North Bihar it is suggested that if land is in plenty and cane is the main crop, the land may either be kept fallow during the monsoon or a green manure crop grown and ploughed in at least by the end of July;but if the land is limited on account of growing food crops the land may be kept under early-maturing crops such as maize or *aus* (early) paddy so that proper cultivation may be given before the rush of *rabi*. In planting a spacing of 3 feet between the lines is suggested in place of 2½ feet. For the better cultivation of land a set of implements (designed by an officer of the Department) consisting of a 'Bihar plough', a 3 or 5 tyned Bihar cultivator and a 'Bihar ridge plough' are suggested for the North Bihar tract. For South Bihar the use of a set of implements known as "Shukhada Implements" consisting of detachable parts capable of being easily fitted on to an ordinary country plough is suggested.

The disposal of cane.—The cane crop of this province is consumed principally in two ways. In South Bihar the harvest is converted into *gur* and in North Bihar it is mostly converted directly into white sugar by well equipped factories. Consumption by chewing is estimated at only 15½ per cent. During the seasons 1932-33 the factories of Bihar crushed 1,494,527 tons of cane or roughly cane from an area of 100,000 acres. 34½ per cent of the total produce is directly converted into white sugar although the factories are capable of taking 40 per cent of the produce. The remaining 50 per cent is converted into *gur*. The manufacture of *gur* is not a paying business at present as *gur* sells sometimes as low as Rs. 1-10-0-per md. in some parts of Bihar. The exceedingly low rate of *gur* in Bihar has given rise to a new industry of manufacturing sugar from *gur* under indigenous and improved methods. But this industry has a doubtful prospect. In spite of all its defects the manufacture of *gur* will remain the most suitable outlet till a large number of factories are established to deal with the whole cane area.

The average cost of production of sugarcane in Bihar is Rs.100 per acre and the yield is 400 mds. of cane. The factory rate of cane (during the season 1932-33) was Rs. -/5/6 per md. Allowing for interest on capital there seems to be no profit in the cultivation of cane. but during this period of depression sugarcane is probably the only crop which fetches some return. If this low rate for cane continues for some years more the sugar industry of Bihar may collapse. The factories however cannot be blamed as making undue profits by paying such low price for cane to

the grower. All the factories of Bihar at present suffer from the evil of discontinuous working on account of an ill-adjusted system of cane supply. Due to discontinuous working the factories are unable to make much profit even when the rate for cane is low. On the other hand there is a national loss to the extent of about rupees two lakhs annually from Bihar alone due to the loss of sucrose that is caused by delay in transit. About 32 per cent of available sugar is lost if four days elapse between harvest and crushing. The fault therefore lies in the defective cane supply. By the establishment of a proper system of cane supply it is possible for the manufacturers to strengthen the sugar industry of Bihar. In this connection the Imperial Sugar Technologist proposed a joint stock syndicate comprised exclusively of factories to deal with this problem. But the scheme appears very partial towards the manufaturers in so far as it sets up a buyer's combine against the poor and disunited peasants. Mr. Padhye of Bombay suggests a co-operative system of cane supply on the lines followed in St. Kitts and Antigua. If the sugar manufacturers of Bihar intend to build up their industry on a sound and permanent basis they should forget that they are independent bodies. They should come to a co-operative agreement with the producer of cane by offering the later the inducement of a bonus from the profits. This would ensure a steady supply of cane to the factories.

On account of the recent earthquake of January 1934, seven sugar factories were put out of action having sustained damages of varying nature. This has precipitated a crisis for the cane grower as there is no demand for the cane. In view of the fact that white sugar industry has been in existence in this area from a very long time, some of the cultivators have forgotten the art of *gur* making; nor have they the requisite appliances for the manufacture of *gur*. Thus the disposal of 150 lakhs maunds of surplus sugarcane was a serious problem. The Local Government, however, readily proposed to provide free of cost 3,250 units of bullock driven sugarcane crushing mills and *gur* boiling pans. They also agreed to give loans on favourable terms to planters and zemindars wishing to set up khandsari power plants. Mills were obtained. Trained mechanics were also engaged by the supyling firms to give free service to people in case of breakdown. Twenty parties of agricultural overseers and kamdars were deputed to teach the cultivators the process of *gur* making. The cultivators are thus assured of the continuous service of these men during the *gur* making season. Moreover a Cane Marketing Board has been set up. This board has arranged for an adequate supply of railway wagons

for the carriage of cane from distressed areas to certain mills outside those areas at reduced rates. The effect of the earthquake on agricultural lands has been serious but no definite report has so far come forth. South Bihar still remains an unexplored region for the development of the sugar industry; the prospects of the sugar industry in Bihar are not altogether lost.

Extracts

THE FUTURE OF AGRICULTURAL SCIENCE.

BY SIR DANIEL HALL, K.C.B., LL.D., F.R.S.*

I owe you an apology for attempting in an informal talk to assume the position of a reviewer of the way agricultural science is being pursued at the present time. I would like to begin by asking you to bear in mind the enormous increase in the specialization of science. I recall, for example, that it is almost exactly fifty years since I was taking my final examinations at Oxford in chemistry; and, at that time, students who were taking the Honours School of chemistry at Oxford were expected to be acquainted with the whole of that science and to have read it right up to current research. We were expected to be able to answer questions about investigations that had been published, say, within a year of taking our examination. That was only fifty years ago. There was, indeed, a differentiation between organic and inorganic chemistry; but the more modern differentiations of physical chemistry, etc., were entirely unthought of. Then, as I say, one man was supposed to be able to cover the whole subject. At the present time, of course, no man pretends to know the whole of physical chemistry, still less the whole of chemistry, even if he is spending his life at it, and is not merely an undergraduate undergoing his final examination.

I think the same thing holds true very much with regard to the progress and the methods of agricultural research. Looking back, I realize that the formal organization of agricultural research in England has taken place during my lifetime, although research existed, of course, long before then. The Experimental Station at Rothamsted began nearly a century ago, but it was then a private institution, receiving no

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assistance from the State. It did, in fact, represent, with one or two minor exceptions, the whole of the agricultural research that was then going on in Great Britain.

Somewhere in the late "eighties," and more particularly in the "nineties," organized agricultural research got a start in Great Britain; and when I look back upon my colleagues of that time, who were recruited from the various fields of science to begin the new work, I see a very different type of man from the current research worker, for, in those days, a man was supposed to be able to cover the whole field of agriculture and the sciences depending upon it. I can best give you an example by recalling to you the late Professor T. B. Wood, whom many of you knew. For many years he was Director of, and indeed the creator of that great school of agricultural science of Cambridge. Now T. B. Wood was indeed the all-round man of science in connexion with agriculture. He was a farmer in the first instance born and bred upon the farm. He went on farming himself; during the whole of his Cambridge career he was running a farm of his own, farming, as he was always proud to say, out of his own cheque book and not with the resources of some institution behind him, and therefore having to make it pay—and indeed he did make it pay. Besides that, he was the head of the inititute of Research in Animal Nutrition at Cambridge. And he was the head of it, that is to say, he was the originator of the methods of work, and he was controlling and directing research in that particular field. He, of course, was head of the School of Agriculture, and, as such, was responsible for the general oversight of the other institutions that dealt with animal diseases and plant breeding at Cambridge. He had papers to his credit on such diverse subjects as the composition of mangolds, the colloids of wheat flour, Mendelian inheritance in sheep, and probable error in experimental plots. Well now, we are not likely again to see men of that type, who have this immense all-round acquaintance with all the developments of science in connexion with agriculture. They were men like the Greek, Milo of Crete, who by practising with a calf gradually grew up to be able to carry a bull. Nowadays, the investigator is confronted with a full-grown bull, and cannot begin to learn to carry it.

Specialization, then, is a fact to be faced. We recognize the enormous power of the specialist, his way of penetrating into the mysteries; and, in agriculture, we are concerned with that most mysterious of all things, life. Yet we have to guard against some of the dangers to which

our research is exposed. The danger arises, perhaps, from the interest of the subject itself. If you get a man working intimately, closely, with some broblem of soil or of disease, he becomes so fascinated with the pursuit of knowledge that the end to which his researches are directed is forgotten in the interests of the problem itself. The means, as it were, become far more important than the end. This is almost inevitably so; and, of course, some of these problems, as in soil physics or some of the elusive problems of mycology or of genetics, lead on and on with no prospect of finality, so that the investigator settles down, as it were, for life. He will have colleagues in other countries similarly carried away by this intense specialization, until in the end a sort of bridge party is made up. A worker in the United States "leads"; somebody in Jugo-Slavia plays the next card; there is a third person in England perhaps, who joins in; and then you have a fourth from Holland or Sweeden to play. These people all exchange papers with one another. They all feel very important and are entirely interested, but wholly indifferent to those outside the party. I had an instance in my laboratory not long ago, when one of my colleagues had prepared a paper. I toiled over this paper, day after day, trying to get it, as I thought, intelligible at any rate, intelligible to me and about the tenth day, after talking it over, said: "Look here; you must begin again and write this all over again; it is not really intelligible." And the lady—it was a lady in this case—turned to me and said: "What does it matter—there are only five people in the world who will read it, and they will understand it." Well, that is the sort of game that our science may so easily become.

This high specialization exists; it is inevitable: and we cannot get the best work done, and we cannot solve, or even get an appreciation of, many of the difficult problems that are before us unless we have such specialists each at liberty to go on working in his own way, and pursuing his particular bent to the utmost. But can we not do something to make these people human? In order to do that, let us try to ensure that they have contacts with agriculture itself. In my own particular field, at the present time, I am concerned with genetics and plant breeding. But one has to try to make the young workers, taking up genetics, become interested in plants and in the actual growing of plants. They must not treat the plants that are being grown, perhaps by the thousands for their particular genetical study, as merely laboratory units, but as living things, possessing other points of interest than crossings-over in certain proportions, or chromosomes in certain positions.

What we have to try to ensure is that all our workers are making contacts with the practical men. We do this first of all to ensure that their work will have some immediate practical purpose of course, we must ever remember that the purest scientific work may suddenly bloom into something utilitarian. Just think, for example, of the number of men and of the length of time that was spent in the minute study of the nucleii of plants and animals, work which eventually defined the chromosomes and revealed the processes of mitosis and meiosis. For years and years that was abstract, pure science without the slightest thought that it was ever going to be of any practical value. Suddenly it blossomed, and in the hands of Morgan and his colleagues, this study of the nucleus provided a physical basis for the mendelian generalisations. So we obtained the whole material basis of the regulated breeding of plants and animals out of that bit of abstract, pure science. None the less, I think we are more likely to get even our pure science work vital if we can persuade the workers to be agriculturists, horticulturists, and, above all, naturalists, who have their eyes upon the living, growing organisms. It is peculiarly important in another way. Often, it is only when you turn to the practical man, who is working upon a very large scale with plants or animals, that factors are disclosed, exceptions are thrown up, and difficulties are discovered which do provide a lead, perhaps, into the ocean of pure science itself; and, therefore, it is good, from both the pure science point of view, and the immediate needs of the practical man, that all our research workers should have their ears to the ground.

How can that be done? Well, as a working method, can we not allot to each of our workers in the laboratory, together with his real fundamental problem that may require years of investigation, patience and the collaboration of many people, some proximate, short-term problem that arises from farm or garden itself? The one will give him his contacts and may suggest further long-term problems; the other is, of course, his permanent fixed occupation. I think it is a reasonable way of going to work, to see that the abstract research worker has also a practical investigation, which may bring some immediate help to the farmer of the gardener.

May I pass on to consider, briefly indeed, what are the directions in which scientific research in regard to agriculture may probably be guided most profitably at the present time. I embark upon that question with a little more confidence in that we have recently set up in Great Britain

an Agricultural Research Council, the opposite number to the Committees dealing with Scientific and Industrial Research, and with Medical Research in our country. It has been the duty of this Council to carry out a general review of the agricultural research that is in progress in Great Britain, and, in so doing, it has had, almost necessarily, to think a little about what is going on in the Empire and in other countries. While the review is by no means complete, I think we begin to get the various subjects into a little perspective, and to see something ot their relative importance. Perhaps the subject that has most been pressed upon us, the one which to most people seems to require the most strenuous effort, is the question of animal disease, or rather, as I should put it, the question of ensuring animal health. Many people consider that the most pressing of all the problems before us.

I am bound to say, while reporting this as the general opinion, that I do not personally altogether agree, because I am looking at the problem from the point of view of health rather than of disease. I see the task of the people who are dealing with the health side of animals to be, in future, very much more hygiene and the maintenance of health than the cure of disease. What I would like to see is a class of veterinarians who are officers of animal health rather than practitioners. There must always be practitioners who are concerned with surgical cases and with specific illnesses of valuable animals, but it seems to me that the great efforts of the profession should be rather of a public nature. Instead of being called in to this ailing cow, or to that fretting horse, we want to see a class of men who have charge of a district, who are thinking about the horses, the cattle, the sheep and the pigs and how to keep diseases away from them. Naturally, they will have to know about the endemic diseases, but breeding, environment, nutrition, and other factors in hygiene will be equally important. I think that is going to be the direction in which the veterinary profession itself will eventually move, and that the veterinarian of the future will be the kind of public officer who is taking prophylactic and preventive measures and who is studying problems like nutrition and so-forth, so as to ensure a greater amount of health amongst the animal population. It is only latterly that we have really begun to appreciate what an enormous factor nutrition is in the health of live stock; we do not even yet know all that is necessary.

From another point of view I think we shall really have to attack these problems of animal disease and their occurrence from the genetic

standpoint. We know of course already, in dealing with plants, how a great number of diseases can effectively be dealt with by breeding immune races. We have succeeded in breeding races of potatoes which are immune from wart disease (Synchitrium endobioticum), a disease which a few years ago threatened to wipe out potato growing in many districts of Great Britain. In all kinds of directions we can see how the most profitable and certain attack upon diseases in plants is to breed a race that is immune. We cannot dispense with measures of spraying at the present time because it takes time to breed immune varieties–first to find immunity, and then to breed from it. And when you are dealing with fruit - well, a generation of apples in our country means seven years, and so the research worker will not get very many generations in his own lifetime. Still, this line of attack has been so profitably pursued in many directions that one can be reasonably sure that, in the end, our real method of dealing with disease in plants will be from the genetic side. I think the same method will come amongst animals. There are instances which show you that certain kinds of immunity are inherited through characters subject to laws of inheritance that have been worked out for other characters. If, then, we are given time and space and numbers, I think we can do much to create races which will be immune to many of the diseases that cause such large monetary losses at the present time.

This leads me on to consider another very big problem before us. Many of our economic problems in dealing with animals, besides this one of disease, can be solved if we can only set to work at the breeding of animals with the same intensity, and on a scale comparable with the methods, that we have employed with plans. It is going to be a more difficult matter because of the complications due to sex, difficult also by environmental conditions as well as by genetic make-up. We shall have to deal with large numbers of animals, and that means expense. Such work again, becomes difficult because we have to fight to a certain extent against the inherited traditions of the farming community. I say we have to fight against the inherited traditions because we do come up against the devotion of the best farmers to their conception of pedigree. If you are going to set to work and breed, say a new type of sheep that shall combine a great many advantages at present scattered about amongst the different breeds of sheep, you at once are opposed both by the vested interests in existing breeds, and by that instinctive, persistent, long-inherited tradition of the farmer that pedigree is a thing to look to for its own sake,

Pedigree was a great step in its day, and the principles that were laid down by the earliest breeders of animals have done marvellous things in improving live stock. Yet, as you all know, pedigree that is founded simply upon records of breeding and upon show performance is not really sufficient. I have been interested to notice how much progress you are making in Canada in working out performance records and new types of pedigree for many classes of live stock that will, for instance, in regard to milch cows, show records of performance in the past - records of the performance not only of the dam, but records of performance of the bull showing his ability to get better milk producing stock. We are tentatively beginning to recognize performance records of that kind with regard to the breeding of pigs. We do not simply want to know that the boar is of such a line and won such-and-such prizes at various shows; we want to know the record of the litters he got, and how steadily he carried with him a commercial degree of prolificacy. For all the animals that we have to deal with, we need this new conception of pedigree, one that is based upon performance and will be an assurance of performance in the future.

I want, however, to go further than that, and to begin re-creating. I do deliberately say that the time has come when our knowledge of the laws of inheritance, that have been worked out in connexion with the smaller animals at the present time, has become sufficient to enable us to step forward and create new breeds. I call them synthetic breeds, because I want to put together within our new breeds many of the excellent characteristics that at present are confined, perhaps to one or two breeds only. It certainly can be done. The only question is whether any of us will have the courage to set to work upon a scale, and to face up to the financial expense that such breeding will involve during the early stages.

One can begin to see not only that the time is ripe for such work from the scientific point of view, in that we are beginning to have sufficient knowledge of how to breed for milk or wool, but that we are perhaps getting to the stage when we can see from the economic point of view how it can be done. After all, we are not in Great Britain just beginning to feel out towards—I will not say simply cooperation in agriculture—but towards a planned agriculture. A planned agriculture will involve a certain amount of direction and control of methods—though not necessarily the actual work—of the farm. At the present time, when contributions for research are being cut down, it would not be much

good asking for a farm of adequate size, and, say, 20. 000 head of cattle to begin a new breed. yet, if there is a central market control, it ought not to be so difficult to ensure the cooperation of. we will say, 200 farmers —each with a certain number of cattle—towards such a common objective, that the cattle are all to be bred under direction, generation after generation, towards a new synthesis, a new type of breed. It is quite true that, at first, you would be producing a set of mongrels: but then the loss to each individual through the mongrels would never be great, and would disappear as the new breed emerged. I believe that some such organization will make it possible to ensure a genetic improvement in our existing breeds of live stock.

I am bound, however, to tell you that, when I have thrown this idea out in public in Great Britain, it has been received in the coldest fashion by any farmer who happens to hear it.

On this occasion, talking in an informal way, you will not want me to say anything about the problems of genetics in plants, particularly the problems of disease and that most insidious class of diseases lumped together as virus diseases. Sometime, there may be another occasion on which I shall be able to deal with these questions. Nor, again, do I think this the occasion to discuss many of the new lines of thought that have been pointed out for us in considering problems of the soil.

If there is one other line of research which one really would like to say something about, it is the field that is opening up with regard to the minute physiology of plants. One of the difficulties in dealing with plant physiology in the past has been the purely technical one of analysis. New methods of micro-analysis are being worked out to an extraordinary degree, and appliances that are being put at the disposal of the research worker engaged with the intimate physiology of plants are altogether outside our conception of even twenty years ago. It was only the other day, when I was in Pasadena, that I was shown the methods by which microanlysis of the chromosomes is being attacked at the present time. It is now possible to identify certain mineral elements in particular chromosomes of a plant. Well, that is pushing refined analysis to an extreme ; and, as I say, in the light of these methods and some of the results that have already accrued, I believe this is going to be one of the most fertile lines of attack that remain open before us. It is an extraordinary difficult method to follow, but one which will have

a bearing upon our practical problems of plant growth in many and diverse directions.

However much we look over the field of agricultural science, and research work in connexion with it, we are sooner or later up against the big economic problem, what is the good of all our science, and what is the good of all our research, if the fundamental basis of agriculture as a means of enabling men to live by tilling the soil and raising animals, is wrong; if the farmer cannot get a living, and if the improvement that we can promise from our science weigh so little that they cannot overcome these fundamental economic problems ? This point of view is something that those of us who are dealing with research in agriculture cannot afford to put of our minds ; that, behind all our efforts, behind all the improvements that we may suggest, behind the transformations that we can make in our farming, we have to consider the ultimate transformation of the farming individual. Yours is almost single-man farming, ours a little more organized into small capitalist units; how are such men to be fitted into the organization that modern thought, modern science, modern improvements seem to demand? The demand is insistent-the human mind once having got upon this efficiency track will go on pursuing it. The agricultural problem is how to ensure this type of efficiency while, at the same time, not effecting utter social disorganization by entirely knocking out the individual peasent farmer. At present the competition between the peasant and the great organization is still, perhaps, a little doubtful. I do not think the case for the big organized scientific farm has yet been proved up to the hilt.

Only the other day, I was taken over one of these big organized ranches in Southern California, something like 6,500 acres, chiefly under fruit crops of one kind or another, all managed with the sort of efficiency and organization that we normally associate with the factory. The control of labour and materials, the organization of transport and marketing-all, from a casual inspection, and some examination of the books and records, seemed to me just about as good as you would possibly get. Yet, with all that, the people who are running the farm confessed to me that they did not know whether they were really going to succeed or not,as compared with the little individual man who had his ten or twelve acres of oranges or of apricots,and did all the work himself.

The utmost advantages as I say, of organization and science, wealth

and capital, and so on-big business in excelsis-were still fighting a not-certainly victorious battle aginst the family farmer, who is willing to put in his twelve or sixteen hours a day on his own little potato patch. Well, I cannot but think that,in the end,the big man with his form of organization is going to win out. Up to the present time,the individual has kept his end up by working twelve hours a day, and by indenting upon the time of his wife and his children. In many countries, he shows that he is getting rather tired of the job and prefers to earn wages at the factory that has sprung up nearby; or,at any rate, if he sticks it out, his children are not disposed to carry on in quite the same way. We can see, in the old World, the disintegration of the peasant system under the attraction of industry and the pressure on prices started by the big organized farm,which in many quarters has progressed far enough to have made the living of the peasant very precarious.

As I say,that is the ultimate problem that is before us. We are all aiming at efficiency, the more efficient production of plant food from the soil, and the more efficient conversion of that same plant food into animal food. Every time we have one of these revivals in efficiency-and revivals have been effected within our time-there is a renewed attack upon what is after all the mainstay of farming all over the world-the individual, single-man, peasant cultivator. I think it is up to us to have that problem always before us and to see that economic investigations go hand in hand with our scientific investigations. The one great objective in these economic investigations ought to be to see how far it is possible to organize these individuals, who are at present, week, scattered units-to organize them so that they can take their part in one of these big, efficient organizations and yet remain still independent human beings, inheriting the value of their own initiative and hard work.

THE AGRICULTURAL DEVELOPMENT OF INDIA.

The following extracts are taken from the resolution dated 5th May 1934 issued by the Government of India laying down the future lines of Agricultural economic development in this country. The resolution is the outcome of a joint conference of the representatives of the Govenment of India and the various provincial governments held at Delhi early in April.

Agricultural indebtedness.—The primary object of the conference in this matter was to provide an opportunity for an exchange of ideas between provinces and to obtain impressions in the light of the most recent information and experience both as to the prevailing conditions and as to the practical results of such measures as have been already adopted. These discussions proved to be of great value; but it must be emphasised that they are to be regarded only as a preliminary review conducted for the purpose of elucidating lines for further enquiry and action.

The problem was considered in all its aspects. First, the problem of existing indebtedness and the possibility of scaling down debts, secondly, the problem of finance in connection with such schemes and thirdly, the problem of providing suitable credit machinery for the future and restricting usurious practices. In connection with the second and third problems consideration was given to the possibility of establishing land mortgage banks and to the functions of the Agricultural Credit Department of the Reserve Bank.

The general view of the conference was that the diversity of the conditions of the agricultural classes in India was so great, both in respect of land tenures and general economic status, that any legislative measures to afford relief must be primarily provincial; but that at the same time it was highly desirable that the various local Governments should know what other local Governments were doing to meet the situation and that there should be a regular exchange of information on this matter. The Government of India are considering the procedure most likely to effect this purpose in an expeditious manner.

Land Mortgage Banks.—The essential problem in connection with such institutions in India lies in the realisation of their security—land. The restrictions on the transferability of land, or the rights over land, and in consequence expense, uncertainty, and delay in obtaining and executing decrees constitute real obstacles to the development of such banks. Conditions in this respect vary greatly from province to province, and the representatives of several provinces were quite definite in their opinion that the dangers of tampering with the land laws and increasing the facilities for the alienation of land were so great as to outweigh the advantages for improving the character of the security on which credit could be obtained. Whatever the possibility of future development may be, it is clear that, in view of these opinions and the differences in condi-

tions, the responsibility for policy as regards establishing land mortgage banks must rest with the provincial Governments. The Government of India will be very ready to assist by giving their technical advice in regard to provincial schemes or otherwise, and will see that the Reserve Bank is organised to do so in the future. But it is for the provincial Governments to face the fundamental issue, and to decide, if they desire to have such institutions, how far it is possible to provide them with a realisable security as a basis for their loans.

Agricultural Credit Department of the Reserve Bank.—In discussing the improvement of credit facilities for agricultural operations, the functions of the Agricultural Credit Department of the Reserve Bank came before the conference. This department will of course be in contact with all agencies operating for agricultural credit—joint stock banks, indigenous bankers or money-lenders, and co-operative credit societies. The discussions at the conference concentrated attention on the last mentioned agency. They disclosed the fact that in most provinces the co-operative movement was in difficulties and that in several cases the difficulties gave cause for anxiety. Whatever may be the reasons for this position, the practical fact which for the present purpose requires emphasis is that, if the Agricultural Credit Department of the Reserve Bank is to function usefully in relation to agricultural requirements, it will have to avail itself to a considerable extent of the provincial co-operative movement. In order to put the board of the Bank into a position to take early decisions for the inauguration of this department, the Government of India have decided to appoint an expert officer on special duty to examine and report what would be the most suitable organisation and in what manner it may most effectively work in with the co-operative banks and other agencies for advancing credit to the agriculturists and landowners. The Government of India have, for this special work, appointed Mr. M. L. Darling, I. C. S., an officer who has had prolonged practical experience of co-operative and agricultural credit in the Punjab and who has also studied the co-operative movement in other countries. Mr. Darling will take up his duties early in June.

On the whole question of agricultural indebtedness the general conclusion of the conference was that while measures for dealing with debts in the form of special legislation or otherwise varying with the needs and the conditions of each province might be necessary, such measures were essentially temporary expedients and palliatives, and that in the

absence of changes either in the mental outlook of the agriculturist or in his economic opportunities, they were likely to result merely in fresh debts being incurred from the original creditors so that the position would speedily revert to its original state. Such measures therefore, if they are to serve a really useful purpose, must be supplemented by constructive action of a more permanent character, embodying a policy of economic and social development. This obviously raised very wide issues. It was not possible within the time available fully to explore all these aspects of the question (especially such important points as the part that education and rural betterment schemes should play in modifying the economic outlook of the ryot); but the discussions served to clear the ground and indicate possible methods by which the various problems could be more fully examined. There was no formal agenda and provincial Governments were invited to bring forward for discussion any matter which they considered relevent and important.

The following paragraphs deal with certain lines of action in the economic field on which definite conclusions were reached.

Marketing.—The discussion of this subject resulted in general agreement that of all the practicable measures for improving economic conditions, an intensive programme to develop marketing facilities for agricultural products (both crops and animal products) offers the best immediate prospect of substantial results. The Government of India consider that the discussions at the conference have amply demonstrated the necessity for vigorous action, not merely with a view to promoting the production of particular commodities, but even more with a view to safeguarding India's future in the face of intensified outside competition which is being felt as a result of modern scientific and economic developments in other competing countries. The discussions entered on the following main problems :—

(*a*) How can the demand, both internal and external, for each individual commodity be promoted ?

(*b*) How can the gap between prices paid by the consumer and those received by the producer be reduced and the agriculturist's share of the final price increased ?

(*c*) How can the agriculturist be protected from those seasonal slumps in the prices of commodities which are occasioned by the fact that whilst the consumption is spread more

or less evenly over the year the harvesting and marketing are, concentrated in a relatively short period ?

(*d*) How can the agriculturist be most cheaply and safely financed (i) for the production, and (ii) for the marketing of his produce ?

The action to be taken to deal with the above problems includes propaganda and the supply of information in external markets regarding Indian products ; the grading sorting and bulking of the main staple products ; special market organisations for perishable commodities information to Indian producers of consumers' requirements both in India and abroad ; the planning of production on the basis of quality and demand ; the establishment and development of regulated markets ; the undertaking of market surveys for the purpose of developing a common plan throughout India ; the establishment of properly organised 'futures' markets, commodity exchanges and ware-houses.

As regards the organisations which should be set up to secure the objects noted above, the Government of India consider, in agreement with the general conclusions reached at the conference, that in regard to each individual commodity (or group of commodities) marketing will have to be studied from a number of aspects, and that, while Government assistance will be required for the initial steps, the ultimate objective to be aimed at will probably be to establish special 'commodity committees' (on the lines of the India Central Cotton Committee) each charged with the improvement of the marketing of a particular commodity or group of related commodities.

The programme provisionally approved at the conference included the following initial steps :—

(1) The appointment of a central marketing officer by the Government of India ;

(2) The appointment of provincial marketing officers;

(3) The inauguration of provincial marketing surveys;

(4) The appointment of special committees for staple crops starting with oil-seeds and tobacco;

(5) Work on grade standards under the direction of the Imperial Council of Agricultural Research.

The Government of India have decided to proceed on these lines. The first step-the appointment of a central marketing officer-has already been taken. The officer selected has just arrived in India and the further steps noted above will be elaborated after discussion with him and in consultation with provincial Governments. The question of providing the necessary funds needs further discussion, but the Government of India are prepared to recognise that this programme is a matter of all India importance and to provide the bulk of the expenditure from their own resources.

The steps outlined above have been stated with primary reference to the marketing of crops, but the marketing surveys will also include animal husbandry products. It is accordingly proposed that the central marketing officer should be assisted by a deputy and two assistants to deal with animal husbandry products.

Further, as regards dairy products in particular, in order to study the problems involved in their preparation for wider markets it is proposed to supplement the Imperial Institute of Animal Husbandry and Dairying at Bangalore by the addition of a Dairy Industry Institute which will include a laboratory for carrying out research on the physical and chemical properties of Indian milk and its reactions to the various forms of processing and transport under Indian conditions.

There was also general support at the conference for the establishment of provincial dairying committee to study and develop local marketing arrangements. The Government of India is addressing local Governments on this matter.

Crop Planning.—An essential complement to any programme for marketing is the regulation of production in adjustment to the demand. The discussions initiated by the Government of Madras and the Punjab on rice and wheat disclosed the danger of serious relative over-production of these important crops having regard to the world position, and as regards wheat, as the results of the rapid opening up of the areas irrigated by the Sukkur Barrage. On the other hand, it is to be remembered that the demand for other crops, or for products of animal husbandry in substitution for crops, may be relatively more favourable, and in particular that the Ottawa preferences have created new opportunities for Indian produce in the British market (notably for linseed,

barley, etc.) of which it is vitally important that India should take full advantage. The Government of India consider that it is a matter of most urgent importance that all possible steps should be taken to co-ordinate a plan of agricultural production for India as a whole, and they have therefore decided, in agreement with the conclusions reached in these discussions, to propose to the provincial Governments that a conference shall be held at the earliest possible date of provincial Directors of Agriculture and land revenue officers to discuss what measures can be taken in this direction. It is important that such measures as are immediately possible should be taken before the sowing season for the next cold weather.

Indian Trade Commissioners.—Among plans for the development of markets for Indian products it should also be recorded that the Government of India have now decided actively to resume the programme for the appointment of Indian trade commissioners in foreign countries which had been temporarily suspended as part of the economy campaign.

Capital Programme.—As a means of improving the economic equipment of the country, and incidentally of increasing purchasing power by distributing employment during this period of depression, the conference also considered the scope for central expenditure on public work of various kinds. The present occasion is particularly opportune for such a policy, in view of the fact that money can now be borrowed at unusually low rates and that land, labour and material, etc., are much cheaper than they were a few years ago. A general review was accordingly undertaken of the possibilities in this direction. The review covered a wide field; irrigation, both by canals and tube wells, the reclamation of waterlogged areas, and the prospects of electric power schemes in various province were discussed and the results compared. Particular attention was directed to road development and the view was generally accepted that if, in the terms of the Road Resolution, which has now been sanctioned by Central Legislature, the grants to provinces from the Road Fund can be utilised for the service of loans raised for the construction of roads and for the maintenance of roads so constructed, this will be a great inducement for the provincial Governments to put forward comprehensive plans. It was recognised that the main initiative in the matter of capital expenditure must come from the provinces because most schemes will be in respect of provincial subjects, and provincial Governments have been asked to supply, as early as possible, forecasts of those schemes which

they consider will be in a broad sense productive. The present juncture, when there are signs that the weakening processes of increasing economic depression have been checked, may provide an opportunity when a comparatively small stimulus in the form of capital expenditure by Government might, by increasing employment and consequently consumption, have far-reaching effects. On the other hand, hastily prepared schemes may lead to very considerable loses, the burden of which will have to be borne by the tax payer of the future, so that the preparatory work must not be scamped. For this reason it is desirable that the preliminary forecasts should be prepared as soon as possible so that the range of possible expenditure may be determined without unduly delaying the necessary detailed preparation of each scheme.

Industrial Research.—As the attention of the conference was primarily concentrated on agricultural problems, the main lines of Government's policy for the encouragement of industry by means of protection and other wise were not fully discussed. The vital importance of this side of economic development was of course fully recognised both for its own sake and as a means of improving the home market for agricultural products.

At the same time the development of cottage industries as a supplement to agricultural operation was considered.

Special attention was given to industrial research and the question discussed of establishing a central organisation for this purpose, on the lines of the Imperial Council of Agricultural Research. The general feeling of the provincial representatives was that the most immediate need was for a central clearing house of industrial intelligence which could keep abreast of industrial developments, both in India and other countries, and be in a position to give information and advice to industrialists and persons seeking industrial openings. The functions of such an institution might be somewhat as follows:—

The collection and dissemination of industrial intelligence.

Collaboration with provincial Directors of Industries and industrialists in all matters relating to industrial research.

Publication at intervals of bulletins relating to industrial research and other matters connected with industrial development.

Assistance to industrialists in India by giving advice and making suggestions as to the directions in which research should be undertaken.

To collaborate with the various organisations of the central and local Governments with a view to ensuring that specifications prepared or issued by them provide as far as possible for industrial standardisation.

To assist in the organisation of industrial exhibitions in India.

The officer at the head of such an institution could also be charged with the duty of organising future industries' conferences.

The Government of India have decided to establish a central bureau on the above lines, and in order to give it an essentially practical character, and to ensure that it shall keep in close contact with industrial markets and current business, it is proposed that the bureau should be attached to the Inian Stores Department, the establishment of which has already had a very marked effect in promoting the development of Indian industries.

While a plan on these lines seems likely to meet the most immediate practical requirements, the Government of India do not fail to recognise that further public assistance for the promotion of industrial research may be necessary. Occasions may arise when *ad hoc* grants to scientific institutions for research on a special problem may be required, while in the case of one particular industry-the sugar industry-they have already acknowledged the need for the establishment, with Government support of a central research institute. In this connection it may also be recorded that the Government of India have decided to give a grant for sericulture research, and another grant for the encouragement of the handloom industry. The experience gained from the working of the Central Intelligence Bureau described above may indicate what are the needs for further steps in the way of industrial research.

Economic Surveys and Statistics.—In this connection the Government of India took advantage of the presence of the provincial representatives to discuss with them the report by Dr. Bowley and Mr. Robertson on a scheme for an economic census of India with special reference to a census of production and the reorganisation of statistics. As that report had only just been received and as the Government of India had consequently not the opportunity to study it, no definite decisions were reached and

the report will be dealt with separately. The general opinion was, however, recorded that an improvement of the organisation for the collection and distribution of economic information was urgently desirable and that for the formulation of an economic policy a reliable survey of existing condition was necessary. It was noted in particular that the recent restoration of inland railborne statistics had been of the greatest possible value to provincial Governments in dealing with the problems connected with their crops and particularly to the Punjab in respect of wheat. In this connection the steps taken by various provincial Governments to set up advisory economic boards or boards of economic enquiry were discussed and the results compared.

Conclusions.—The steps covered by the decisions noted above are to be regarded as initiating a coordinated policy for economic improvement while the conference itself has special significance as a recognition of the fact that for the proper development of such a policy close co-operation between the central and provincial Governments is necessary. The Government of India wish to put on record their conviction that the conference has served a very useful purpose in enabling them to consider the whole range of vitally important problems in the economic sphere, and to express their thanks to the provincial Governments for sending members of their Governments to represent them at such short notice.

Gleanings

Improving the keeping quality of plantains.—A series of experiments were conducted at Jalgaon (Bombay Presidency) to find out methods of preventing deterioration of plantains during transit. During long Journeys plantains become spoiled by rotting and by developing dark spots on the skin. It is found that this deterioration of fruits can be controlled by treating the cut ends of the bunch with paraffin wax or candle wax. The following advantages are observed from this treatment. (1) It increases the keeping quality of the plantain fruits on the bunch. (2) The fruits remain in a fresh condition for a longer period (3) Plantains do not drop from the stalk (4) Fruits get good yellowish attractive colour when ripe and no dark spots are formed. (5) Rotting of fruits is appreciably checked.

It is therefore recommended that all plantain growers and dealers should

adopt this practice. The practice is very simple. Soon after cutting of the stalk from the plant melted paraffin wax should be applied to the cut surface of the stalk. Paraffin wax is easily available in all towns and it costs annas four to six per pound. One pound will be sufficient to treat more than 100 bunches of plantains. (*Leaflet No. 6 Department of Agriculture, Bombay*).

Fighting Locusts from the air.—A new method of fighting locusts from the air has been discovered by Mr. H. H. King formerly Chief Entomologist to the Sudan Government. As a result of his researches Mr. King has found that adult locusts particularly those on the wing fall an easy victim to a spray of finely ground sodium arsenate. He made proposals for an experimental discharge of this dust from aeroplanes to the Locust Central Council of the Economic Advisory Committee. The grant has been voted by the Council and the experiment is shortly to be tried in Northern Rhodesia. Mr. King's experiments if successful will result in saving a large part of the world from the depradations of this most destructive insect enemy of the Agriculturist. Mr. King's plan is to fly to and fro across the line of advance of the swarms of locusts and fill the air with this fine poison dust discharged from special blowers mounted on the wings of the aeroplane. No danger to human beings crops and live stock is likely to arise from the use of the poison dust in view of the fact that the natural dissipation of the cloud reduces its density within a short time to a point at which its effects are no longer poisonous (*The Hindu, 23rd April 1934*).

Progress of Debt Conciliation in C. P.—The Debt Conciliation Act was brought into force on the 1st April 1933. Two Debt Conciliation Boards were established in July for the Khurrai tahsil and the Seoni sub-division each consisting of an official chairman and four non-official members.

The Khurrai board.—Out of 1783 applications involving claims of 21.61 lakhs agreements were executed in 48 cases for Rs. 1. 36 lakhs in satisfaction of loans amounting to Rs. 2. 35 lakhs. 131 applications involving claims of about 1 lakh were dismissed under section 7 and 133 cases involving 1.90 lakhs under section 14 of the Act. 1291 applications involving claims of Rs. 16. 36 lakhs were pending on the 1st January 1934.

Seoni board.—Out of 560 applications involving claims of 10. 81 lakhs agreements were executed in 97 cases for Rs 65,000 in satisfaction of loans amounting to Rs. 1. 03 lakhs. 51 cases involving Rs. 2. 7 lakhs were dismissed under section 14 of the act. 400 applications involving claims of Rs. 6.45 lakhs were pending on the 1st January 1934.

Government has decided to establish a third board at Balaghat in February. A proposal for making provision for six boards for the next financial year is under consideration. The Berar Legislative Committee has adopted the Central Provinces Act for application to Berar with a few modifications and the sanction of the Gonvernor General is awaited. (*C. P. Legislative Council Proceedings, February 1934*).

Women farmers in America.—"Farm women have made a valiant effort to maintain a desirable standard of living for their families, in spite of the conditions during the last ten years. The small income from the sale of a farm woman's garden vegetables, or her eggs or poultry, or butter and other dairy products, or even her own baking, has, in some cases, been the only cash coming into a farm home. Because single sales were for small amounts, this income was formerly looked upon as "pin money" in comparison with the expected yield from the major farm corps or livestock. At present, by means of it, the women on the farm is at times keeping the whole family ship afloat. For example, I know a farm woman's market in Maryland where seventy-six of the women have paid farm taxes from their sales. Their gardens and poultry and canned goods have provided the family with good food, too, and many of them bartered what they could do, for what they lacked, either goods or services. The viewpoint and outlook of farm women in many countries has been persistently optimistic and constructive. They have not only helped to feed their families, but they have cared for their households as usual, made and made over much clothing and revived many home industries to save money. They make cheese and soap, do dry cleaning, can and cure meats, and can and dry vegetables and fruits." (*Report of the Director of Extension work for the United States Department of Agriculture*).

Dry farming Research.—The Imperial Council of Agricultural Research has recently sanctioned several schemes of Research on Dry Farming in areas of precarious rain-fall. In the Madras Presidency the work will be done at the Hagair Agricultural Station in the Bellary District. This Station is situated in the centre of a vast area of uncertain rainfall. Most of this area receives less than 20 inches of rain in a year. It is said that during the last hundred years this area had six famines, five scarcities and a number of bad seasons. In the Bombay Presidency the work will be done at Sholapur which is again situated in a distinct famine zone. In Hyderabad the work will be done at Raichur. Attempt is being made to avoid duplication of work. The research involves the study of problems like soil moisture in relation to plant growth, conservation of

soil moisture and increasing its availability, study of the crops of the tract and the introduction of new varieties.

New bottle cleaning materials.—In the past soda and carbonate of soda have been almost the only materials used for washing the bottles. These are now supplemented by the silicate of soda which has a cleaning and grease removing action, and by trisodium phosphate which forms emulsions with grease and also serves to remove grease. Soda when used alone with hard water gives an opaque bottle as a result of the deposits of the carbonate of sodium and magnesium formed from the combination of the soda with the bicarbonate of the water. Disodium phosphates acts as a dispersing agent as the precipitated particles are coated with water and so easily removed by the washing water. The quantity of disodium phosphate to be added depends on the hardness of water. The formula of 200 to 300 grains of disodium phosphate for 3 kg. of crystalline caustic soda may be modified by experience. *(Inter. Rev. of Agri)*.

Citric acid from tobacco.—At the Panunion Institute of the Tobacco Industry of Soviet Russia interesting research has been carried out showing that tobaccos of inferior quality and more especially the 'Makhorka' are very rich in citric acid. This tobacco contains from 6 to 8 per cent whereas the the citron contains about 6 per cent. Experiments carried out at the Institute of Krasnodar in a plant of semi-industrial character established for the purpose prove that citric acid may be recovered from the waste of 'Makhorka' tobacco in an economical and profitable manner, for the whole of the acid may be recovered after the extraction of the nicotin, in which this tobacco is rich, better than by treating the tobacco directly *(Inter. Rev. Agri.)*

A new type of winnowing machine.— Mr. J. A. Miller Brownlie Agricultural Engineer Punjab has succeeded in constructing a new type of winnower with a blower of the impeller type which is said to be a new development in winnower design. It comprises a steel frame on which is mounted a six blade fan of the impeller type, five feet in diameter discharging 25,000 cubic feet of air per minute at a velocity of fourteen miles per hour and having an efficiency of over 95 per cent. Surrounding the fan and carried on three rollers of the drum type is a conveyor of flexible ladder and scraper of the bucket type. The buckets or scrapers carry the grain and chaff mixture upon a nearly vertical guide plane and thence over a horizontal distribution platform above the fan. This platform is cut away at an angle to its length thus permitting the contents of each bucket to discharge gradually over the entire length of

the cut on to a shunt in front of the fan. Thus a continuous stream of the grain and chaff mixture in the form of a curtain of width less than the diameter of the fan and thickness just over one inch fills into the air current and at right angles to that current. The gearing and capacity of the machine is arranged to deliver 43 maunds of mixture per hour and actual trials show that a small percentage in excess of the designed quantity can be loaded by two men. To operate the machine at full capacity only O. 9 horse power is required and of this 0. 07 horse power is utilised by the elevator and the balance 0. 83 horse power is required to produce the wind velocity of 14 miles an hour. A small oil engine of 1 ½ horse power is built into the frame work and has ample margin of power for continued service in the high temperatures prevailing at the harvest season (*Agriculture and Livestock in India, January 1934*).

Current Research

Investigation on the storage of Mangoes by B. N. Banerjee, D. V. Karmarkar and G. R. Rao (*Agriculture and Livestock in India* Vol. IV 1934 page 36).— The skin of the mango harbours a large number of fungi and becteria, among which an aerobic bacterium and a fungus most prominently act as agents causing the decay of the fruit. During cold storage (O°C.) the growth of the putrefactive organisms is not encouraged. Preliminary treatment of the fruit prior to storage is not very helpful. Mechanical injury to the fruit affects the ripening and is highly detrimental to the keeping quality of the fruit. At 15°C. the rate of ripening of the mango is half that at the ordinary temperature (25.27°C). At still lower temperatures the rate or ripening is lowered still further, but near about 5°C. all cell activity comes to a stop. Dry atmosphere and adequate ventilation are necessary for ripening and for the storage of mangoes. Carbon dioxide gas has a retarding effect on the process of ripening. Mature mangoes can be made to ripen in 20-25 days at between 5 to 10°C. The ripening can, if necessary, be hastened by raising the temperature to 25. 30°C. At 0°C. fully ripe mangoes can be stored in good condition for 3-5 weeks. Ripe mangoes and sliced pulps preserved in syrup keep well for 3-4 months. Although the edible quality of the fruit can be preserved for a further period, yet the pulp becomes very soft and thus suffers in quality. Slight acidification of the syrup with vinegar, tartaric acid, or citric acid further helps the preservation. Presence of a small quantity of sulphur dioxide in the syrup helps to preserve the mango in perfect colour, shape, and edible quality for over a year. The combined evidence obtained from the present research

show that mango can be preserved as fresh fruit for 7 weeks from the date of plucking. When stored in sugar syrup plus an antiseptic, the fruit can remain sweet for over a year.

The Relative Growth Rate, the Carbohydrate Contents and the yield of the Rice Plant (Oryza sativa, L.) under Different Treatments. R. H. Dastur and A. R. Pirzada *(Ind. Jour. Agri. Sci. 3, 963)*.— The relative growth rates, the carbohydrate contents and the yield of the rise plant, Columba variety No. 42, manured once but at four different stages of growth with ammoniacal nitrogen, nitrate nitrogen and a mixture of the two and of unmanured plants, are determined. The relative growth of the rice plant reaches its maximum in the second half of August and the maximum effect of each fertilizer is obtained when the plants are manured in the middle of August. The highest relative growth rate is shown by the plants manuredby a mixture of ammonium sulphate and sodium nitrate. The carbohydrate analysis of the unmanured and manured plants shows the same features as the growth analyses. The carbohydrate contents of the plants manured with the mixture on the 15th August are the highest. The manuring of the plants later than the 14th August results in decreased growth rate and yield and very little beneficial effect of manuring plants at the flowering stage is obtained. The fact about manuring the plants with nitrogenous fertilizers when its relative growth rate is highest holds good for the other fertilizers like the superphosphate. *(Authors' abstract)*.

Rusts of wheat and Barley in India. A study of their annual Recurrence, Life-histories and Physiologic Forms. K. C. Mehta *(Ind. Jour. Agric. Sci. 3,939)*.— Annual outbreaks of yellow rusts of wheat and barley on the plains of India are caused by wind-blown uredospores, which are disseminated from comparatively high altitudes in the hills, where alone these two rusts oversummer. As far as the plains are concerned, species of Berberis and Thalictrum, the alternate hosts for black rust of cereals and the brown rust of wheat respectively seem to play little part in the yearly origin of those rusts. Berberis vulgaris, raised from foreign seed, has been successfully infected by sporidia of black rust of wheat in this country. Brown rust of wheat and the black rusts of wheat and barley are in all probability disseminated to the plains from comparatively low altitudes, where they can oversummer. Study of rust dissemination by wind has yielded very interesting results. So far only four physiologic forms of black rust and two of brown have been met with. There is a strong evidence, both circumstantial and scientific, in support of the writer's contention, that the number of physiologic forms of the rusts under study should not be large in this country. For the reasons given above, the

possibility of controlling rusts in India, is infinitely greater than elsewhere (*Author's abstract*).

The Decomposition of Green Manures in Soil. J. A. Daji (*The Jour. of Agri. Sci. XXIV, 1934 p. 15*)—In the present paper the decomposition of green manures in soil under laboratory conditions has been followed by determining periodically the changes taking place in the various plant constituents, such as the carbohydrates and allied products (Series I) and the nitrogen transformations (Series 11). Four plant materials of widely different origin and age were used as green manures mixed with soil for decomposition studies under laboratory conditions. Provided the conditions of temperature, moisture aeration, and micro-flora, are optimal, the decomposition depends upon the chemical constituents of the plant materials. It is shown that the soluble carbohydrates, hemicelluloses and cellulose are the compounds mainly responsible for the loss of total organic matter during decomposition. Plant materials containing a balanced proportion of available carbohydrate compounds to available nitrogenous compounds decompose rapidly. Those containing excess of nitrogenous compounds decompose more rapidly and those containing excess of carbohydrate compounds decompose less rapidly. This is true in all cases whether the plant material is a legume or a non-legume. Young plant materials by virtue of their abundance of available nitrogenous compounds decompose more quickly than mature tissues. When comparatively young plant materials are used as green manure, there is the danger of a loss of nitrogen, the loss depending upon the amount of total and available nitrogen this contains. Not only do they lose nitrogen but they decompose very rapidly, with the result that nitrates accumulate soon after burial. Unless the succeeding crop is sown sufficiently early to utilise these nitrates, they are likely to be lost through leaching under field conditions. (*Author's summary*).

Cotton Anthracnose in the Central Provinces. *J. F. Dastur* (*Indian Journal of Agricultural Science Vol. IV, 1934 p, 100*).—A new anthracnose disease of cotton bolls and cotton seedling is described. This disease is different from the one known in America and some other places, where it is caused by Glomerella gossypii (Southw.) Edg. Evidence is produced to show that the cause of the epidemic in 1931 was due to high atmospheric humidity in October of the year. The disease is carried in the seed. Microscopic characters of an infected seed are described in detail. Hyphae are found inside the seed-coat and it is suggested that they get there through the funicular end. Germination of diseased seeds is found to be poor. Seedlings from infected seeds are liable to be killed by the fungus from the diseased seed. Remedial meausres

found effective in raising the percentage of healthy seedlings from diseased seed are, treating the seed with uspulun, sulphuric acid or copper carbonate. The fungus is provisionally named Colletotricum indicum Dust. (*Author's summary*).

The formation, evolution, reclamation and the absorbed bases of Alkali soils. by W. P. Kelley (*Jour. of Agri. Sci. Vol. XXIV, 1934 P. 72*).—The formation of alkali soils is primarily a question of soluble salt accumulation. Those processes which bring about the accumulation of soluble salts in soils also tend to cause the accumulation of $CaCo^3$. Under certain conditions simple calcium silicates may also be precipitated in alkali soils. Hilgard's researches were concerned chiefly with the soluble salts. On the other hand, more recent investigators have emphasised the base-exchange aspects of the subject. Sodium salts tend to react with the clay and humus constituents of the soil, converting them into Na-absorption compounds. These components produce extremely adverse conditions in the soil. Under certain conditions alkali soils tend to pass through four evolutionary stages, namely salinisation, alkalinisation desalinisation, and degradation. As to whether or not an alkali soil will pass beyond the salination stage, depends on the composition of the soluble salts that accumulate in it. Where sodium salts predominate, more or less alkalinisation of the exchange complex has taken place. However this is not true where soluble calcium is relatively abundant. Desalinisation (by leaching, whether natural or artificial) of alkalinised soil is usually accompanied by the formation of Na_2CO_3 and by pronounced deflocculation. If $CaCO_3$ be present, the formation of Na_2CO_3 is accompanied by the replacement of absorbed sodium by calcium. Under these conditions the degradation stage will not be attained. If $CaCO_3$ be absent, base-unsaturated constituents arise under leaching conditions, and more or less of the inorganic-exchange complex becomes decomposed into simple oxides. The volutionary stage of the soil predetermines, in considerable measure, what reclamation process should be employed. If the soil has not passed beyond the salinisation stage, simple leaching will effect satisfactory reclamation. This conclusion has been verified by plot experiments in the Imperial Valley, California. If the exchange complex has become alkalinised to any important extent, the absorbed sodium must be replaced by calcium. This can be accomplished either by treating the soil with a soluble calcium salt and leaching, or by reducing the PH-ion concentration of the soil to a point where $CaCO_3$, if present, will react with the Na-absorption compounds. Experiments near Fresno, California, have demonstrated the effectiveness of gypsum and sulphur as treatments for strongly alkaline sodium soil. It has been found also that prolonged leaching will accomplish the reclamation of this

soil. Upon leaching, $CaCO_3$ gradually reacts with the exchange complex of this soil, converting the same into calcium absorption compounds. The same result can be more quickly produced by applying sulphur, iron sulphate, alum, or other acid materials. Degraded alkali soil can be reclaimed, as de, 'Sigmond has shown, by applying lime. Alkali soils may contain carbonates and simple silicates of calcium and magnesium. This fact makes difficult the determination of the absorbed calcium and magnesium. In addition to the soluble salts, which Hilgard emphasised especially, and the base-exchange constituents, which Gedroiz, de 'Sigmond, and others have emphasised, the author wishes to direct attention to the calcium constituents of alkali soils. The amount and kind of calcium minerals in the soil predetermine both its evolutionary trend and the method of reclamation that should be employed. (*Author's summary*).

Crop Forecasts

Final Forecast 1933-34.

WHEAT

Central Provinces and Berar.—On an average of the five years ending 1930-31, the area under wheat in the Central Provinces and Berar has amounted to nearly 10.3 per cent of the total area under the crop in British India. The ratio of the irrigated to the total wheat area (a) in British India and (b) in the Central Provinces and Berar in the five year ending 1930-31, avaraged (a) 39.8 per cent and (b) 1.0 per eent respectively.

Area.—The area in the Central Provinces and Berar stands at 3,441,850 acres against 3,513,009 acres of last year, decrease of 2 per cent. It however exceeds the 5 and 10 years, average by 2 and 7 per cent, respectively.

Outturn.—In consequence of the out turns reported in the third forecast having been now lowered by district officers by 7.5 points in Jubbulpore, Mandla and Buldana, the provincial outturn works out to 73 per cent of the normal against 76 per cent reported last year.

Expressed in tons, the yield for the province amounts to 650,200 tons against an actual outturn of 673,400 tons of last year.

LINSEED.

Central Provinces and Berar.—On an average of five years ending 1930-31, the area under linseed (single crop and after crop) in the Central Provinces and Berar has amounted to nearly 25.0 per cent of the total area under the crop in British India.

Area.—The provincial area is now reported to be 996,823 acres (drilled 571,232 and broadcast 425, 591) which is larger than the area, 937,922 acres reported in the second by 58,901 acres or by 6 per cent. It also exceeds the actual area of last year and the quinquennial and decennial average by 6.15 and 3 per cent, respectively.

Outturn.—The crop has been affected by lack of winter rains, cloudy weather, frost in the northern districts and untimely rain and hail in February and the first week of March. The estimates of Outturns reported in the second forecast have been lowerd in Jubbulpore, Mandla and Chhidwara by 22.5 points, in Bhandara, Balaghat, Raipur and Buldana by 15 points and in 4 other districts by 5 to 7.5 points. In Chhattisgarh which furnishes nearly two-thirds of the total area under the crop and in Saugor, Nimar and Betul the outturns now range between 90 and 97.5 per cent while in the rest of the province, it ranges from 45 per cent in Chhindwara to 82.5 per cent in Hoshangabad and Balaghat. For the province as a whole the outturn now works out to 84 per cent against a normal crop of last year.

Expressed in tons, the yield for the whole province amounts to 80,900 tons as against 87,100 tons of last year, a decrease of, 6,200 tons or 7 per cent.

Calender of Operations

FLOWERS

By R. N. Sinha.

May.—The cold weather annuals will have finished by now. Their seeds should be gathered and cleaned and dried and preserved in air-tight bottles or tins with labels for next year's use. Seeds like Aster, Pink, Phlox, sweet-peas, Petunias, Candytuft, Nasturtium, Cornflower, Alys-

sum, Antirrhinum, Larkspur, Clarkia etc. do not deteriorate for two or three years.

When the seeds have been collected, the plants should be pulled out as soon as possible, and the beds dug out to a depth of about 2 feet, and the excavated soil left exposed to sun and air for about 2 or 3 weeks.

Afterwards well rotted cattle-dung manure in the proportion of two of soil and one of manure may be well mixed with the soil and returned to the pits. Horse dung, night-soil or town sweepings can also be added with advantage, of course in a well decayed form.

Potting soil for general use may be prepared in the following form and kept ready for use during the rains.

2 Parts soil; silt preferable.
1 Part cattle dung.
1 Part leaf mould.
1/4 Part sand in absence of silt.
1/8 Part charcoal dust.

Seed beds should be prepared and kept ready for sowing early in June. These beds should be about 4½ feet in width and 9" higher than the ground level. The length may be according to requirements. A mixture of cattle dung and leaf mould manure in the proportion of half and half would make a suitable composition for seed beds. A layer of this about 1½" in thickness would be enough over the seed beds. Manures like horse-dung and Poudrette should be avoided for seed beds as far as possible. It would be worth while soaking the seed beds 10 or 12 days before the actual date of sowing the seeds.

The following seeds may be ordered for the rainy season.

1. Zinnia.
2. Balsam.
3. Cosmos.
4. Sunflower Big.
5. Sunflower small.
6. Celosia.
7. Gomphrena.
8. Melampodium.
9. Torenia.
10. Hollyhock.
11. Marigold.
12. Cacalia.
13. Gillardia.
14. Calandula.
15. Datura.
16. Amaranthus.

Where hedges or borders are to be planted, a trench 1½ feet deep and 1½ feet broad may be dug and the soil exposed to the sun. If manure is available easily, it may be added in the proportion of 3 to 1. and the trench filled in and kept ready for sowing the seeds or inserting cutting of hedges and borders.

The following varieties are suitable for hedges and borders :—

Hedges.	Borders.
1. Haematoylon.	1. Eupatorium.
2. Ingadulcis.	2. Pedilanthus.
3. Dodonia.	3. Pedilanthus variegata.
4. Duranta.	4. Justicia.
	5. Althernanthera.

Surface drains should be cleaned and new ones dug, wherever necessary. Drainage is one of the important factors in plant life.

Caladium and Amaranthus bulbs should be removed from storage and made to sprout by about the middle of this month. Dhalia tubers should be potted in leaf mould for sprouting. Caladium and Hemanthus bulbs can be potted independently after separating the bulbs, the size of the pot depending upon the size of the blubs. Put a little fine sand round about the bulbs while potting. Charcoal dust will be valuable in caladium soil for obtaining good colours.

June.—The seeds obtained in the last month for the rainy season may be sown in two lots, the first lot on or about the 6th and the second lot a week later. The seedlings will be fit for transplanting in about 2 to 3 weeks time.

Dahlia bulbs will be fit enough for separating by the 1st week. These may be potted in 6" and 8" pots.

Roses will have to be pruned and manured by about the 3rd week. Pruning need not be heavy in this season.

It is advisable to prune the ornamental and flowering shrubs also

by the end of this month in order to keep them in shape and control, and to encourage their free flowering tendency.

This is the best time for sowing seeds or for planting cuttings of hedges and borders.

Cannas may be transplanted in this month. Violets and Geraniums in pots may be removed to some shady open verandah in order to protect them from the rains or other-wise they would be spoiled.

The rooted cuttings of Eduard Rose may be potted in pots or planted in beds for budding in the next cold season.

July.—Any operations which could not be finished in the last month may be carried out in this month with safety.

This would be the proper time for re-potting potted plants.

Croton cuttings may be planted in a mixture, of coarse sand and leaf mould manure. In this month Dahlias will be getting ready for putting in big pots.

Hanging baskets may be renewed. Rockeries also should be renewed or new ones planted. Whenever possible, the flower beds planted in the last month should be hoed or their soil loosened by a *khurpee*.

For obtaining good results, remove the first flowers of zinnias, which are genarally single ones. Remove the side shoots of balsams, as flowers produced on the stem are always double, full, and more showy.

Examination Results, 1933-34

B. Ag. EXAMINATION NAGPUR, UNIVERSITY

1st Division.
Damodar Misra*
Mohd. Zafarali Khan
2nd Division.
A. M. Chaudhary
B. P. Dwivedi
G. C. Baruah
H. Misra
K. B. Rahurkar
L. B. Deshpande
N. P. Konher
P. V. Bhagwat
P. Tiwari
P. M. Joseph
S. L. Nema
S. S. Ambadekar
3rd Division.
D. N. Gour
Pass Division.
G. N. Deshpande
S. K. Dharmadhikary
H. P. Mishra
Mohd. Ishak

G. L. Deshkar (Compartmental)

*Awarded the Chakradeo Memorial Medal and the Sir Arthur Blennerhassett Memorial Medal.

INTERMEDIATE EXAMINATION NAGPUR, UNIVERSITY

First Division.
M. S. Nair*
T. J. John
R. S. Shivalkar
Second Division.
B. L. Udhalikar
D. Chandrayya
D. R. Soman
G. L. Chandore
H. N. Mukerji
Lal Harnarayan Singh
M. D. Anadeo
N. V. Bapat
U. G. Deshpande
Pass Division.
D. P. Sharma
Radhelal Gupta
Syed Shariful Hasan
W. R. Deshpande (Compartmental)

*Awarded the Sir Arthur Blennerhassett Memorial Médal.

THIRD YEAR PROMOTION EXAMINATION

In Order of Merit

1. K. G. Joshi
2. V. G. Vaidya
3. D. Patnaik
4. Bishwanath Sahu
5. A. B. S. Verma
6. N. N. Bhide
7. T. P. S. Chaudhary
8. H. R. Shrivastava
9. S. K. Bhise
10. S. N. Walkade
11. P. N. Soman
12. B. R. Dutt
13. Haribansa Misra
14. P. M. Ganorkar
15. G. M. Bawsay
16. B. S. Venugopal Rao
17. V. S. Hingankar
18. K. G. Wadnekar
19. K. R. Chande
20. N. W. Tilloo
21. K. S. S. Chauhan
22. S. C. Bhandari
23. Purnanand Misra
24. G. W. Pitale
25. Y. K. Dabhadkar
26. S. A. Rasheed
27. Shariful Hasan
28. S. G. P. Tiwari
29. R. D. Mukerji

FIRST YEAR PROMOTION EXAMINATION

In Order of Merit

1. Syed Kazim Hussain
2. A. B. Mitra
3. Mohd. Luqman
4. S. Kufallikar
5. Gajraj Singh
6. V. N. Andhare
7. D. P. Parsai
8. Md. Nasiruddin
9. K. U. Tathode
10. B. P. Upadhyaya
11. W. S. Debadrai
12. K. R. P. Nair
13. S. P. Pimplikar
14. D. B. Das
15. B. V. Bhatt
16. R. D. Joshi
17. V. S. Saoji
18. S. R. Shakergayan
19. D. D. Moharikar
20. P. K. Mukerji
21. V. S. Kulkarni
22. C. P. Mehta
23. P. Harinkhere
24. D. V. Deshpande

Departmental News

Rao Shahib G. K. Kelkar officiating Deputy Director of Agriculture, Eastern Circle is confirmed in the Central Provinces Agricultural Service Class I (new scale) with effect from the 7th February 1934 in an existing vacancy.

* * * *

Mr. D. V. Bal officiating Agricultural Chemist in the Central Provinces Agricultural Service Class I is confirmed in the appointment in the new scale.

* * * *

Leave on average pay for four months is granted to Mr. N. G. Sule, offg. Extra Assistant Director of Agriculture, Amraoti with effect from the 1st May 1934 or any subsequent date from which he may be permitted to avail himself of it.

* * * *

On termination of the temporary appointment of Marketing Officer Mr. J. S. Gurjar is reappointed as officiating Extra Assistant Director of Agriculture, with effect from the 1st May 1934 and is posted to Akola.

On relief by Mr. Gurjar, Mr. G. M. Joshi, officiating Extra Assistant Director of Agriculture, Akola, is posted to Amraoti in the same capacity, vice Mr. Sule on leave.

* * * *

Leave on average pay for one month is granted to Mr. A. R. Padmanabha Aiyer, Extra Assistant Director of Agriculture, Nagpur, with effect from the 21st May 1934 or any subsequent date from which he may be permitted to avail himself of it.

* * * *

Mr. K. A. Mahmud, Assistant to Mycologist to Government, Central Provinces, Nagpur, is granted leave on average pay for one month from 15th March 1934 to 14th April 1934.

* * * *

Leave on average pay for 10 days is granted to Mr. M. B. Malwatkar, Agricultural Assistant, Wun, with effeet from the 10th April 1934 or any subsequent date from which he avails himself of the same.

* * *

Mr. N. G. Shirpurkar, Agriecultural Assistant, attached to Buldana Farm is transferred and posted to Khamgaon to work during the absence of Mr. A. H. Barde on leave.

On relief by Mr. N. G. Shirpurkar, Agricultural Assistant, leave on average pay for one month is granted to Mr. A. H. Barde, Agricultural Assistant, Khamgaon, with effect from the 12th May 1934 or any subsequent date from which he avails himself of it.

* *

Leave on average pay for 15 days is granted to Mr. G. B. Deshmukh, Farm Superintendent Buldana, with effect from the 20th May 1934 or any subsequent date from which he avails himself of the same.

Mr. N. K. Nerikar, Agricultural Assistant attached to the Seed and Demonstration Farm Buldana, will work as Farm Superintendent Buldana *vice* Mr. G. B. Deshmukh on leave.

The Nagpur Agricultural College Magazine

VOL. IX NO. 1

AUGUST 1934

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Contents.

The Nagpur Agricultural College Magazine

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Editorial

INDIA AND THE OTTAWA AGREEMENT

Much interest has been aroused by the publication of the report by Dr. Meek on the effect of the Ottawa Agreement on India's foreign trade. Let it be borne in mind, at the outset, that a Pact which involves so many countries, which may even have a different bearing on different interests in one and the same country will inevitably be viewed from many conflicting angles. There may be a tendency for any one country to think in terms of the comparative benefits that have accrued to other countries within the Empire rather than in terms of the actual benefits that have accrued to itself, and some countries may be critical of the extent to which other countries have given effect to the preferences agreed upon at Ottawa. Again, it does not follow that the views of one industry will necessarily tally with the views of another industry in the same country. The British oilseed-crushing industry's opinion, for instance, may be very different from the opinion of the British firms which export chemicals and hardware to India.

The enquirer who attempts to assess the working of the Agreement, even from the point of view of one country, is confronted with a problem of very great complexity. The economic and financial necessities of individual nations have affected the normal flow of international trade to such an extent during the

past two years that it is virtually impossible to disentangle the specific effect of the agreement from the effect of all the other factors involved. For the same reason, it is difficult to visualize, with any approach to precision, what the position would have been to-day had the preferences never come into operation.

All these difficulties have been faithfully reflected in Dr. Meek's report which is generally admitted to be a fair and impartial review of India's trade position. It deals in detail with each of the commodities in respect of which India's export trade enjoys a preference in the Empire markets, and also with the reciprocal preferences which India grants on commodities which she imports. Our chief concern here is the exports which consist very largely of raw agricultural produce; and we may further narrow down the discussion on Empire trade to India's export trade with the United Kingdom because, apparently, the preferences granted by self-governing colonies have had little effect on Indian trade.

It will be convenient to consider exports under four categories, namely,

(*a*) commodities the trade in which has definitely expanded as a result of the preferences;

(*b*) commodities which the preferences have helped to retain their footing in the United Kingdom;

(*c*) commodities whose position in the United Kingdom market does not appear to have been affected by the preferences ;

(*d*) commodities in respect of which trade with the United Kingdom has increased but the total trade has diminished.

In the first category come vegetable oils, linseed, hides and skins. In respect of vegetable oils, both the total trade as well as the trade with the United Kingdom has shown a substantial increase since the preference came into operation. This expansion is due to the fact that the market for vegetable oils in the United Kingdom alone is greater than the total volume of Indian exports to all countries. In 1933 India was responsible for 95% of the total imports of groundnut oil into the United Kingdom as against 40% in 1932 and 5% in 1931. Similarly, exports of linseed, both to the United Kingdom and to other countries, increased enormously during 1933-34 as compared with the preceding two years, but the increase to the United Kingdom was of much larger dimensions than in the case of other countries, amounting to 175,000 tons as compared with 14,000 tons in 1931-32 and 1932-33. Some critics of the Agreement ascribe the improved position of linseed entirely to crop failure in the Argentine, but it is only reasonable to concede that the preference has helped India to oust the Argentine linseed from the United Kingdom market and that it will certainly help her to maintain that position. The preference on hides and skins has secured for India 90% of the United Kingdom's import trade. It is interesting to note that out of shipments totalling over 1200 bales from Madras in the last week of August, all but 12 bales were consigned to the United Kingdom.

In the second category may be placed coffee, tobacco, jute manufactures and hemp. In spite of the fact that the total imports of coffee into the United Kingdom from all sources have shown a considerable decline in the past four years, India has been enabled to retain her share which, without the perference, would certainly have been reduced. It appears, however, that the quality of Indian coffee suffers by comparison with coffee from competing countries. As regards tobacco it is claimed that the

preference has been of immense value to India in maintaining her position in the United Kingdom market in the face of American competition. In respect of jute manufactures, India has maintained and even slightly improved her position in the British market. The proportion of Indian jute manufactures taken by the United Kingdom is still very small however—only 8%. The position of hemp, too, has improved slightly.

The most important commodities which find a place in the third category are wheat and tea. The preference of two shillings a quarter on wheat has not led to any appreciable export, the reasons being, firstly, that India's normal production at present prices can easily be absorbed for her domestic consumption; secondly, the heavy crop of 1933 in the wheat importing countries; and, thirdly, the fact that the price of Indian wheat was above parity, the price of wheat in Karachi being higher than that of Canadian wheat in London. Dr. Meek is of opinion that the value of the preference even in the near future, is problematic. It is interesting, however, to read that some consignments, the first in the last five years, have been booked for shipment to the United Kingdom in September. With regard to tea, the value of the preference of twopence per lb. enjoyed by India in the United Kingdom market has been obscured by the operation of the Export Restriction Scheme under which both production and exports from India, Ceylon and Java are controlled. This has naturally led to a reduction in the United Kingdom's imports. But the restrictions have led to a substantial rise in prices and India's percentage share of the trade of the United Kingdom has not diminished. It would seem that expansion of the tea trade as between those three countries is likely to depend more on propaganda than on the preference.

Of the commodities which come under the fourth category rice is the most important. The export of rice to the United

Kingdom amounted to 90,000 tons in 1933, which was more than double the quantity in 1932 and three times as much as in 1931. But the increase in the amount taken by the United Kingdom did not counterbalance the loss in the volume of trade with other countries. The effectiveness of the preference of one penny per pound on cleansed rice has apparently been endangered by an invasion of the United Kingdom market by foreign paddy which is subject to a duty of only 10% *ad valorem*. This led the recent Indian Crop Planning Conference to propose that the *ad valorem* duty on foreign paddy should be replaced by a specific duty of three farthings per lb., a recommendation which was subsequently endorsed by the Imperial Council of Agricultural Research. The report points out that the general foreign demand for Indian rice is adversely affected by its deficiency in flavour and cooking properties, as well as in finish and polish, in comparison with the competing Spanish and American produce. This criticism suggests the necessity for concerted action in three directions, (1) the isolation and further improvement of the finer quality varieties; (2) the setting up of grades or standards which will ensure for the finer qualities adequate recognition in the market; and (3) an improvement in the existing methods of primary processing. Until India can offer rice of the quailty desired no preforence is likely to achieve its maxmum effect in the United Kingdom.

In the case of castor-seed the preference has enabled India to oust other competitors from the United Kingdom but apparently there has been no increase in her total export trade in this commodity.

The position of raw cotton with respect to the Ottawa Agreement is that an undertaking was given at the Conference to explore the possibilities of encouraging increased consumption of Indian cotton in the United Kingdom. Exports to the United Kingdom have increased considerably during the past year, but it is difficult to isolate the precise effect of the undertaking from

the effect of the price factor in relation to American cotton. Opinion which is critical of the Agreement ascribes the improved position to the fact that Indian cotton is below parity, but it ignores the point that similar market conditions in the past have not stimulated the demand for India's raw cotton in the United Kingdom to the same extent.

There is a tendency among a section of public opinion in India to condemn the Agreement on the ground that India's trade, on the whole, has not expanded since the preferences came into force, and to ascribe this condition to retaliatory measures on the part of countries outside the Agreement. That view is difficult to justify. World trade conditions are not even yet favourable to expansion. All countries are absorbed in the problem of maintaining or restoring a favourable balance of trade, and at the same time securing the maximum development of their own agriculture and industries. These objectives, in combination with the world-wide lack of co-ordination in prices, have led to the imposition, to an ever-increasing extent, of tariffs, quotas and exchange restrictions which are the real impediments to the expansion of India's foreign trade. The impediments did not originate from the Agreement. On the contrary they justify its existence.

Original Articles

STATISTICAL ANALYSIS OF THE RESULTS OF SIMPLE EXPERIMENTS LAID OUT IN RANDOMIZED BLOCKS AND LATIN SQUARES.*

BY N. K. DAS, L.Ag. (Hons.)

Laying out agricultural field experiments on the models of Fisher's Randomized Blocks and Latin Square is nowadays quite common in

* Readers interested in the subject will do well to read carefully the very illuminating statistical notes published from time to time by Prof. P. C. Mahalanobis in the *Indian Journal of Agricultural Science.*

India. A knowledge of the method of statistical analysis of the results of such experiments is therefore more or less a necessity for every student of agriculture who wishes to conduct field experiments. The writer of this note made an an attempt to acquire some knowledge of the subject and this article is the result thereof. In this note an attempt has been made to describe the mathematical processes employed for the statistical interpretation of simple comparative trials laid out on Fisher's models. The logic of the processes is difficult for the ordinary agricultural student to understand (and the writer makes no pretensions in this respect) but it should not be difficult for him to carry out the processes themselves in proper sequence at least for the interpretation of simple experiments.

Working out the sum of Squared Deviations.—In the statistical analysis of experimental results it is necessary to make use of sums of squared deviations of various series of observations from their means. The sum of squared deviations of a series of observations from its mean is the sum of squares of the differences between the individual observations and the mean. There are several methods for working this out and these will first be considered.

Let the following numbers represent a series of observations:—

56 48 62 54 50

Any one of the following three methods may be used to find out the sum of squared deviations of the series.

Method I.—The mean of the series is obtained by dividing the total of the observations by 5, the number of observations.

Thus:—

Mean= $(56+48+62+54+50) \div 5 = 54$.

Now the differences between the individual observations and the mean may be worked out, squared and added thus:—

Observations.	Deviations from the mean.	Squares.
56	2	4
48	—6	36
62	8	64
54	0	0
50	—4	16
Sum of squared deviations	...	120

B	C	E	A	F	D	D	A	C	E	B	F
A	B	D	F	E	C	E	F	D	A	C	B
D	C	E	B	A	F	C	F	A	D	B	E

There are 36 plots in this lay-out and so there will be 36 observations. It will be possible to work out the sum of squared deviations of this series of observations in the manner explained above. Now, this (total) sum of squared deviations will consist of :—

(1) Sum of squared deviations due to positional differences (blocks)

(2) Sum of squared deviations due to treatments

and

(3) Sum of squared deviations due to random errors of the experiment.

By totalling the yields block by block, we shall get six numbers representing the yields of the six individual blocks. From the block totals is worked out the sum of squared deviations due to positional differences. This is then eliminated from the total sum of squared deviations.

Since there are six blocks there will be 5 corresponding degrees of freedom.

Again, by totalling the plot yields treatment by treatment, we shall get six numbers from which the sum of squared deviations due to treatments can be worked out. This also is subtracted from the total sum of squared deviations.

Since there are six treatments there will be 5 corresponding degrees of freedom.

That part of the total sum of squared deviations which remains unaccounted for after deducting the sum of squared deviations due to blocks and that due to treatments is to be ascribed to error. Out of the total 36—1 or 35 degrees of freedom for the whole experiment, 5 are appropriate to blocks and 5 to treatments; the remaining 25 degrees of freedom are therefore appropriate to error.

Now let B = sum of squared deviations due to blocks;
B^1 = mean square (variance) due to blocks
T = sum of squared deviations due to treatments;
T^1 = mean square due to treatments;
E = sum of squared deviations due to error;
E^1 = mean square due to error;
TT = total sum of squared deviations;
TT^1 = mean square due to the total.

From these, what is known as the Table of Analysis of Variance may be prepared thus :—

Due to—	Degrees of freedom.	Sum of sq. deviations.	Mean square (variance)	$\frac{1}{2}$ log$_e$.
Blocks	5	B	B^1=(B÷5)	*b*
Treatments	5	T	T^1=(T÷5)	*t*
Error	25	E=[TT—(B+T)]	E^1=(E÷25)	*e*
Total ...	35	TT=(B+T+E)	TT^1=(TT÷35)	—

The mean square due to the total is generally not of any use and in actual practice need not be worked out.

If the foregoing discussion has been followed there should be no difficulty in following this table up to the fourth column. In the fifth column are put down *b*, *t*, and *e* to represent half the natural logarithm of each of the three variances, B^1' T^1, and E^1, respectively. The difference between any two numbers in the fifth column is called "*z*" which is used for testing the significance of the difference between the corresponding variances.

The experimenter is primarily interested in testing the significance of the differences beween the treatments. If the variance due to treatments is much greater than that due to error the differential effect of the treatments upon yields is significant. Sometimes, the variance due to treatments may be greater than that due to error purely by chance. It is therefore necessary to determine the significance of the difference between the two variances. For this purpose the z-test is used.

In the above table of analysis of variance let t be greater than e, which is usually the case in practice. Then $t—e$ is our z. Fisher has given tables (*Statistical Methods for Research Workers*—pp. 224-227) showing normal values of z for 5 per cent and 1 per cent levels of significance for n_1 and n_2 where n_1 stands for the number of degrees of freedom corresponding to the larger variance and n_2 for that corresponding to the smaller. In the present case $n_1 = 5$ and $n_2 = 25$. From the tables the 5 per cent point of z will be found to be .4783. If the observed value of z be lower than this, the treatment differences would not be considered significant. If, however, the observed value be higher the odds are at least 100 : 5 or 20 : 1 against such a value occurring by chance and the treatment differences would in such a case be regaded as significant. For more severe test the observed value of z is compared with the corresponding value given under 1 per cent level of significance.

In a similar manner, by taking z as the difference between b and e we may get an idea of the significance of the differences between the blocks due to soil heterogeneity.

Tables of natural logarithms are not always available. The value of $\frac{1}{2}\log_e$ of any number may, however, be obtained by taking the ordinary logarithm (to the base 10) of that number and multiplying it by 1.15129 (which is equal to $\frac{1}{2}\log_e 10$).

Prof. P. C. Mahalanobis * has given tables which enable the z test to be made by methods not requiring the calculation of the natural logarithms. One of the methods is based on a consideration of the ratio between the two variances concerned. In his Tables III and IV are given the normal values of this ratio for 5 per cent and 1 per cent levels of

* Statistical Notes for Agricultural Workers No. 3.—"Auxiliary Tables for Fisher's Z-test in Analysis of Variance"—by Prof. P. C. Mahalanobis: *Ind. Jour. Agri. Sci.* Vol. II Part VI, Dec. 1932.

significance respectively and the observed value of this ratio may be compared directly with the corresponding values given in these tables. Here also n_1 stands for the number of degrees of freedom corresponding to the larger variance and n_2 for that corresponding to the smaller.

When the treatment differences have been found to be significant by the z-test, it is necessary to calculate the standard error of the yields obtained from the different treatments. The standard error of the mean of each plot is given by the formula,

$$\text{S. E.} = \sqrt{\frac{\text{Variance due to error}}{\text{No. of plots devoted to each treatment}}}$$

The standard error of the difference between any pair of the mean yields is then found from the formula,

$$\text{S. E. of difference} = \sqrt{2} \times \text{S. E. of the mean}$$

$$= \sqrt{\frac{2 \times \text{Variance due to error}}{\text{No. of plots devoted to each treatment}}}$$

In order to see whether the difference between the mean yields of any particular pair of treatments is significant or not, the t-test may be applied. "t" is the quotient obtained by dividing the difference between the pair of mean yields by the standard error of the difference. On page 151 of Fisher's book mentioned before will be found a table * which gives the normal expectation of t for various levels of significance and various values of n where n stands for the total number of plots under the pair of treatments *less* 2. If the observed value of t be higher than the corresponding value of t given under 5 per cent probability the difference between the pair of treatments under consideration is regarded as significant; otherwise it is considered insignificant.

In actual practice, the value of t is not worked out at all, but a single critical difference is worked out for all the pairs of treatments. All treatment differences exceeding the critical difference are judged significant and those below it are not considered so. The critical difference is given by the formula,

* In this table P=. 01 means one per cent probability, P=.05 means five per cent probability, and so on.

Critical difference = S. E. of difference × 5 per cent point of t (usually).

This will be found further explained in the first illustrative example.

Ordinarily, differences of over three times the standard error of the mean between the treatments is regarded as significant and the t-test is not made nor is the critical difference worked out.

Presenting results.—The manner in which results of experiments are presented will be evident from the illustrative examples given later on.

The Latin Square.—The following diagram illustrates the simplest form of the Latin Square method of plot arrangement in field trials:—

C	E	A	B	D
D	B	E	C	A
B	C	D	A	E
A	D	B	E	C
E	A	C	D	B

Here the replications are as many as there are treatments under trial; the treatments are *randomized* with this restriction that each treatment occurs only once in each column and once in each row. The plots are all squares or nearly squares and equal in area. With this method of lay-out the sum of squared deviations due to columns as well as that due to rows can be calculated and eliminated from the total sum of squared deviations. The error of the experiment can thus be reduced and the precision of the experiment increased. The method of dealing with the results in this case is essentially the same as that adopted in the case of randomized blocks.

Illustrative examples.*—1. Comparison of crossed *sail* (winter) rices 1933-Karimganj Farm.

No. of types compared	...	...	6
Arrangement	...	...	6 randomized blocks.
Area of each plot	...	...	650 sq. feet.

* The experimental data used in these examples were very kindly given by Mr. P. M. Ganguly, Botanical Assistant on the Karimganj Farm (Assam).

Plan of the experiment. Letter denotes variety while figures give yield of grain in pounds *less* 50.

I	III	V
A 3.81	E 0.63	C 2.25
B 11.97	C 9.72	F — 4.06
C 11.63	F — 0.11	B 5.25
D 0.34	B 8.09	E — 2.56
E — 0.44	A 0.38	D — 1.61
F — 2.55	D 0.41	A — 0.41
B 8.06	C 9.38	E — 3.81
F 5.72	D 2.34	C 6.66
E 4.06	F — 1.16	A 2.06
C 15.67	E 3.27	F — 4.98
D 6.28	A 4.25	B 7.94
A 7.31	B 9.47	D — 2.80
II	**IV**	**VI**

From each of the actual plot yields, 50 has been deducted as the working mean. The above data should now be arranged as in the following table :-

Blocks.	Treatments.						Total	Mean.
	A	B	C	D	E	F		
I	3.81	11.97	11.63	0.34	−0.44	−2.55	24.76	4.13
II	7.31	8.06	15.67	6.28	4.06	5.72	47.10	7.85
III	0.38	8.09	9.72	0.41	0.63	−0.11	19.12	3.19
IV	4.25	9.47	9.38	2.34	3.27	−1.16	27.55	4.59
V	−0.41	5.25	2.25	−1.61	−2.56	−4.06	−1.14	−0.19
VI	2.06	7.94	6.66	−2.80	−3.81	−4.98	5.07	0.85
Total	17.40	50.78	55.31	4.96	1.15	−7.14	122.46	20.42
Mean	2.90	8.46	9.22	0.83	0.19	−1.19		3.40

In order to obtain the total sum of squared deviations of the 36 plot yields, from their mean, it is necessary to add together the squares of the individual yields, as adjusted, and subtract the necessary figure for correction. (Compare Method II for finding out the sum of squared deviations). The sum of squares of the adjusted yields will be found to be 1343.5662. From this is to be subtracted $\text{Total}^2 \div \text{No. of observations} = 22.146^2 \div 36 = 416.5681$. The total corrected sum of squared deviations is therefore $1343.5662 - 416.5681 = 926.9981$.

Next, we proceed to find out the sum of squared deviations due to blocks and that due to treatments (varieties).

Blocks.		**Treatment.**	
Number	square	Number	square
24.76	613.0576	17.40	302.7600
47.10	2218.4100	50.78	2578.6084
19.12	365.5744	55.31	3059.1961
27.55	759.0025	4.06	24.6016
—1.14	1.2996	1.15	1.3225
5.07	25.7049	—7.14	50.9796
	3983.0490		6017.4682
Divide by 6 ...	663.8415	Divide by 6 ...	1002.9114
Subtract ...	416.5681	Subtract ...	416.5681
Sum of sq. deviations ...	247.2734	Sum of sq. deviations ...	586.3433

On the left-hand side, the block totals (of the adjusted table) have been squared and summed. Since each block total is a total of six plots the sum is divided by six before subtracting the correction factor. On the right-hand side the sum of squares of the variety totals is also divided by 6 for exactly similar reason. It should be noted that the same correction factor as was used in working out the total sum of squared deviations has been used in both these cases also.

Analysis of Variance.

Due to	Degrees of freedom.	Sum of sq. deviations.	Mean sq. (variance)
Varieties	5	586.3433	117.2687
Blocks	5	247.2734	49.4547
Error	25	93.3814	3.7353
Total	35	926.9981	—

The ratio, $\dfrac{\text{Variance due to varieties}}{\text{Variance due to error}}$

$$= \frac{117.2687}{3.7353} = 31.39.$$

Looking up Tables III and IV of Prof. Mahalanobis referred to before we find that for $n_1 = 5$ and $n_2 = 25$ the 5 per cent point of the ratio is 2.603 and the 1 per cent point is 3.855. The observed value of the ratio is much greater than even the latter. The odds are therefore very considerably more than 100 : 1 against such a value occurring by chance; in other words, the variety differences are overwhelmingly significant.

[Again, the ratio, $\dfrac{\text{Variance due to blocks}}{\text{Variance due to error}} = \dfrac{49.4547}{3.7353} = 13.24.$]

In this case also $n_1 = 5$ and $n_2 = 25$. therefore the five per cent point of this ratio also is 2.603 and the 1 per cent point is 3.855. The observed value is much higher. So the block differences are very significant.

The results have now to be presented as shown below:—

Average yield	A	B	C	D	E	F	Mean	S. E.
Pounds per plot.	52.90	58.46	59.22	50.83	50.19	48.81	53.40	.79
Maunds per acre.	43.38	47.94	48.56	41.68	41.16	40.02	43.79	.65
Per cent ...	99.06	109.48	110.89	95.18	93.99	91.39	100	1.48

The average yield in pounds per plot may be found from the actual plot yields or by adding 50 (the number subtracted from the actual yields) to the mean yield for each variety in the adjusted table. The factor for multiplying the mean yield in pounds per plot for converting it into yield in maunds per acre will be:—

$$\frac{43560}{650 \times 82} = 0.82.$$

In the third line the yields are expressed as percentages of the general mean.

The standard error of the mean of each plot is

$$\sqrt{\frac{3.7353}{6}} = 0.79 \text{ lb.}$$

This is also converted into maunds per acre and percentage of the general mean.

The standard error of the difference between the mean yields in maunds per acre of any two varieties is $\sqrt{2} \times 0.65$ or 1.414×0.65 or 0.919. (.79 lb. per plot = .65 md. per acre.)

Since an equal number of plots is devoted to each variety the value of n for any pair of varieties will be 10. The 5 per cent point of t for this value of n is 2.228. Therefore in order that the difference between *any* pair may be significant, t should in each case be at least 2.228. In other words,

$\dfrac{\text{Difference (in md. per acre)}}{\text{0.919 (= S. E. of difference)}}$ should at least be 2.228, or the difference should at least be 2.228×0.919 or 2.05. This is the critical difference for any pair of the varieties.

As already mentioned, generally a difference exceeding three times the standard error of the mean is considered significant and the critical difference is not worked out.

It is customary to add a note below the table in which the results are finally presented. In this case the following might suffice:—

"The varieties D, E, and F are below average; A is almost equal to, and B and C are above, average. There is no significant difference between B and C."

If the variance due to treatments or varieties is not found significant by the z-test, no differences between the experimental treatments or varieties are to be regarded as significant.

It must have been evident by this time that statistical interpretation of experimental results is not done in terms of certainties but in terms of probabilities.

II. *Aus* (autumn rice) variety trial, 1933 –Karimganj Farm.

No. of types compared...	...6
Arrangement ...	...Latin square.
Area of each plot ...	...25 sq. ft. (100 plants).

Plan of the Experiment. Letters denote varieties and figures denote yield in tolas per 100 plants *less* 30.

	Columns.						Total	Mean
Rows.	F 4.75	A 7.50	B 12.25	D 0.75	C 4.50	E–4.75	25.00	4.17
	D 3.00	F–5.25	A 1.75	E–0.25	B 0.00	C 2.75	2.00	0.33
	A 12.25	D–3.00	C 1.00	B–1.50	E–9.00	F–6.75	–7.00	–1.17
	B 9.00	C 0.25	E–4.00	A 0.75	F–10.00	D 1.25	–2.75	–0.46
	E 6.25	B 2.25	F–4.75	C 0.00	D–5.50	A 9.75	8.00	1.33
	C 16.25	E 5.00	D 6.50	F 1.25	A 0.50	B 8.50	38.00	6.33
Total	51.50	6.75	12.75	1.00	–19.50	10.75	63.25	—
Mean	8.58	1.13	2.13	0.17	–3.25	1.79	—	1.76

As in the previous example the total sum of squared deviations of the plot yields from their mean may be found out by adding the squares of the yields as adjusted in the above table and subtracting the necessary correction. The sum of the squares will be found to be 1404.9375. The correction factor is $63.25^2 \div 36 = 111.1267$. (Incidentally, it may be mentioned that this figure should also be the product of the total and the general mean in the above table. The actual product in this case is $(63.25 \times 1.76) = 111.32$, or slightly higher than the figure for correction already obtained. This is because the general mean has been worked out correct to two decimal places only). Therefore the total corrected sum of the squared deviations is 1404.9375—111.1267 or 1293.8108.

The variety totals are also necessary and these are worked out below:—

	A	B	C	D	E	F
	12.25	9.00	16.25	3.00	6.25	4.75
	7.50	2.25	0.25	—3.00	5.00	—5.25
	1.75	12.25	1.00	6.50	—4.00	—4.75
	0.75	—1.50	0.00	0.75	—0.25	1.25
	0.50	0.00	4.50	—5.50	—9.00	—10.00
	9.75	8.50	2.75	1.25	—4.75	—6.75
Total ...	32.50	30.50	24.75	3.00	—6.75	—20.75
Mean ...	5.42	5.08	4.13	0.50	—1.13	—3.46

We can now proceed to find out the sums of squared deviations due to (1) columns, (2) rows, and (3) varieties.

Columns.

Numbers		Squares
51.50		2652.2500
6.75		45.5625
12.75		162.5625
1.00		1.0000
—19.50		380.2500
10.75		115.5625
Total	...	3357.1875
Divide by 6	...	559.5313
Subtract	...	111.1267
Sum of sq. deviations	...	448.4046

Rows.

Numbers		Squares
25.00		625.0000
2.00		4.0000
—7.00		49.0000
—2.75		7.5625
8.00		64.0000
38.00		1444.0000
Total	...	2193.5625
Divide by 6	...	365.5938
Subtract	...	111.1267
Sum of sq. deviations	...	254.4671

Varieties.

Numbers		Squares
32.50		1056.2500
30.50		930.2500
24.75		612.5625
3.00		9.0000
—6.75		45.5625
—20.75		430.5625
Total	... ...	3084.1875
Divide by 6	... ...	514.0313
Subtract	... ...	111.1267
Sum of squared deviations	...	402.9046

Analysis of Variance.

Due to-	Degrees of freedom.	Sum of sq. deviations.	Mean sq. (variance).
Varieties.	5	402.9046	80.5809
Rows.	5	254.4671	50.8934
Columns	5	448.4046	89.6809
Error	20	188.0345	9·4017
Total	35	1293.8108	——

$$\text{The ratio, } \frac{\text{Variance due to varieties}}{\text{Variance due to error}} = \frac{80.5809}{9.4017} = 8.57$$

For this ratio $n_1 = 5$ and $n_2 = 20$. For these values of n_1 and n_2 the 5 per cent point will be found to be 2.711 and the 1 per cent point to be 4.103. The observed value is much higher than even the latter. So, the variety differences are highly significant.

$$\text{S. E. of mean} = \sqrt{\frac{9.4017}{6}} = \sqrt{1.57} = 1.25.$$

Results.

Average yield.	Varieties. A	B	C	D	E	F	Mean	S. E. of Mean
Tolas per 100 plants ...	35.42	35.08	34.13	30.50	28.87	26.54	31.76	1.25
Per cent ...	111.52	110.45	107.46	96.03	90.90	83.56	100.00	3.94

The critical difference may now be worked out as in the first example or the differences between the means judged in the light of three times the standard error.

THE CAUVERY - METTUR IRRIGATION SYSTEM.

By K. S. S. Iyer, B.E.

Irrigation is one of the most important factors in Indian agriculture specially in those parts of the country where the rainfall in insufficient either in total quantity or in timely distribution or in both. Though almost the whole of India is subject to the monsoons and the average annual rainfall is about 45 inches yet there are certain regions where the annnal rainfall is as high as 500 inches and others where it is practically nil. There are thus portions of the country which suffer as much from excessive rainfall as others do from drought. Another important characteristc of the rainfall of the country is its unequal distribution throughout the seasons. Moreover it is unfortunately a fact that the lower the average rainfall is, the greater is its liability to serious deviation from the normal and thus throughout the whole of the North-West Frontier Province, Sind, the Punjab, large portions of the United Provinces and Bihar, most of the Madras and Bombay Presidencies exclusive of the coastal tracts and portions of the Central Provinces and Burma in all of which the average annual rainfall is less than 45 to 50 inches, security against periodical famine or scarcity from drought can only be obtained by some artificial means of securing a regular supply of water and in some of the driest tracts such as Sind and parts of the Punjab the production of crops without irrrigation would not be possible at all.

The existence of old irrigation works—such as canals, storage reservoirs, wells, dams across rivers etc.—indicates that irrigation was practised from very early times. In fact—except perhaps for Egypt and Mesopotamia—irrigation in certain parts of India has been regularly resorted to as an aid to agricultural operations for a longer period in history than anywhere else in the world. A serious attempt to improve the methods employed and to extend their benefits to larger areas was made only about half a century ago and the progress made since then has been very rapid and impressive.

India is now on the threshold of a great forward movement in the matter of irrigation. Several works of great magnitude have been recently completed and many more are in process of constructionn. One of these—The Cauvery-Mettur Irrigation System—considered to be the biggest in the British Empire and the largest single block masonry reservoir in the world—was inaugurated by His Excellency Sir George Stanley, Governor of Madras, on the 21st August 1934.

About a century ago Sir Aurthur Cotton suggested that a dam across the Cauvery river would help to regulate the supply of water to the Cauvery Delta, where the North-East monsoon failed, by its capricious character, to supply enough water to the extensive area of irrigated lands. Of two alternative proposals to construct the dam (i) across the River Cauvery or (ii) across its largest tributary Bhavani, the former was decided upon only in 1901. Alternative sites for the dam and estimates of cost were prepared and in 1910 the Madras Government accepted the proposal of Colonel Ellis to construct the dam at Mettur at an estimated cost of Rs. 385 lakhs. The construction of the dam had, however, to be delayed to as late as 1925 due to the outbreak of the Great War and the prolonged discussions and correspondence between the Mysore and Madras Governments regarding the sharing of the surplus waters of the Cauvery. The original site selected for the dam was shifted one mile upstream from considerations of better foundations and surplussing facilities. It may not be out of place here to mention that this long delay in taking up the work on hand was a blessing in disguise, for in June 1924 the Cauvery valley experienced the highest floods in living memory and great havoc was caused thereby. The flood discharge then went up to nearly twice the highest discharge previously recorded. Taking a lesson from these floods the designs were suitably altered to ensure the safety of the work under the worst probable flood conditions in the river.

The Mettur Dam is located 240 miles from the source of the River Cauvery which is in the Western Ghauts near Mercara in Coorg, at an elevation of 4400 feet above sea-level. This river with its tributaries being either under the influence of the South-West monsoon or the North-East monsoon or both in some cases, has a fairly high flow during the irrigation season from June to January except for a small break in the monsoon for about six weeks. The supply of the North-East monsoon being irregular and undependable has, very often, seriously affected the cultivation in the Cauvery Delta and the Mettur Dam has been constructed to overcome this difficulty and secure satisfactory crop production by storing, during the South-West monsoon, the flood discharge of the river which would otherwise go unused into the sea—and distributing it evenly during the succeeding irrigation period.

The waters of the River Cauvery and its tributaries are being used for purposes of irrigation for the past several centuries, more by the inundation system of irrigation than a controlled one. Any amount of improvement in the existing systems could not meet the

requirements of satisfactory irrigation both as regards quantity and season and only a huge reservoir, storing the flood water when available and capable of timely distribution, was found to meet the needs of the day.

The overall length of the dam is 5300 feet and the maximum height in deepest foundations is 214 feet. The thickness of the crest of the dam is 20½ feet carrying a 16 feet roadway and the maximum width at the foundation at the deepest portion of the dam is 171 feet. The width of the river at the site of the Dam is 1100 feet and the maximum depth of storage is 165 feet. The catchment area above the Dam is 16,300 square miles and out of 342,000 million cubic feet of water annually available from the catchment area, the Mettur Reservoir has an effective capacity of 93,500 million cubic feet. The maximum length and width of the waterspread of the reservoir when full are about 34 and 4½ miles respectively when the waterspread area is nearly 59½ square miles. The design allows for a future raising of the Dam by 10 feet to compensate for silting up of the reservoir.

The magnitude and utility of such reservoirs can be better realised when it will be seen that with two such reservoirs across the Cauvery—one at Kannambadi (Krishnarajasagara) in the Mysore State with a storage capacity of 43,934 million cubic feet and the other at Mettur in the Madras Presidency, with a storage capacity of 93,500 million cubic feet about 80 per cent of the flow of the Cauvery will be usefully utilised and these two reservoirs will act as flood moderators in times of extraordinary heavy floods in the river. On a comparison of several large Dams of the world (see page 26) the one at Mettur will be seen to be the largest though constructed very rapidly and economically.

The foundation bed of the Dam consists of Charnockite and gneiss rocks which are almost impervious to water and insoluble in water. To secure water-tightness in the foundations holes were drilled at fairly close intervals throughout the length of the upstream side of the foundations and cement grouted under pressure thus closing any possible fissures in the rock bed. One impervious face of the dam is composed of rubble masonry set in a specially rich mix of cement surki mortar. Behind this impervious face the dam is of concrete in cement and in certain areas, where the work was held up through the cementing towers being busily engaged elsewhere, rubble masonry in cement mortar has been used. About ⅓ of the length of the dam,

towards the right flank end where foundations are not deep and height of dam is less, has been entirely built of rubble masonry.

Name of Dam.	Cost in Lakhs of Rupees.	Masonry contents in million c. ft.	Water storage capacity in million c. ft.	Period of construction in years.
Assuan (Egypt)	367	19.8	37,600	4
New Croton (America)	212	23.1	5,120	14
Sennar (Africa)	847	14.8	22,560	7
Krishnarajasagar (Mysore-India)	250	29.9	43,934	16
Nizamsagar (Hyderabad-India)	366	30.1	25,446	—
Lloyd Dam (Sind-India)	172	21.5	24,198	6
Mettur Dam (South India)	478	54.6	93,500	6

A drainage gallery 7 feet by 7½ feet runs through the dam at a little above the ground level for a length of about 4240 feet. This serves as a longitudinal inspection chamber as well as an outlet for the seepage water, if any, from the foundations. Suitable drainage outlet galleries connecting the above with the downstream face of the dam serve also as entrances to the main gallery. Vertical drainage shafts of precast porous concrete blocks with a central hole one foot in diameter, extending to the full height of the dam are provided at intervals of 15 feet throughout the length of the dam, these being connected to the drainage galleries. There are two rows of these shafts, one immediately behind the impervious face and the other along the the rear edge of the drainage gallery. Percolation water, if any, will find its way into the drainage gallery through these. Thus all possible precautions have been taken to ensure the safety of the dam, as otherwise, any failure of the dam "would result in a disaster comparable with the Great War". The volume of masonry in the dam is about 54.6 million cubic feet. About 206,000 tons of cement costing Rs. 108 lakhs have been used in the construction. The dam is so high that the lake entirely fills the valley and when the river is in flood the excess water spills over a large surplus escape at the end of the valley into the valley below, and after cutting a fresh course for itself there, joins its old course two miles lower down.

The rapid execution of the work was made possible by the use of

machinery. The mixing, elevating and depositing the concrete *in situ* on the dam was done by two moveable concrete towers (the biggest of this type in the world) 303 feet high moving on 64 wheels on 80 feet gauge track in rear of the dam. About 840 tons of concrete could be laid by each in a day. Three giant crushers each capable of breaking 120 tons of stone per hour, specially manufactured for this project, were used to crush the stones required for the concrete.

Two sets of irrigation supply sluices—the high level sluice 50 feet below the sill level of the surplussing sluices—consisting of 8 vents each $10\frac{1}{2}$ feet by 16 feet and the low level sluice with its sill 50 feet further below consisting of 5 vents each 7 feet by 14 feet are built into the Dam. All the sluice gates will be electrically operated, provision also being made for operation by manual labour. The low level suices are designed for a maximum discharge of 30,000 cusecs under a head of 60 feet.

The canal system is situated in the Tanjore District. The water from the reservoir is not as in most cases, directly led through the sluices into the irrigation canals, but is let down the river itself to the Grant Anicut 130 miles downstream from where it is distributed according to irrigation requirements. The main canal will be 106 miles long with branches and distributaries of 694 miles length. The length of field channels will be 1904 miles and the estimated cost of the canal system is about Rs. 200 lakhs. It is estimated that the reservoir will insure about 10,51,000 acres of the old Delta against crop failure due to frequent failure of the North-East Monsoon as at present and bring about 301,000 acres of fresh land under irrigation.

While the sanctioned estimate was Rs. 737.08 lakhs, the actual cost of the entire irrigation scheme will be about 680 lakhs only, of which the cost of 'Headworks' alone is Rs. 480 lakhs and a return of 6% on the capital outlay is expected, though now it is feared the expectation cannot be fulfilled in view of the low prices of agricultural produce. The cost of the canal system was brought down by the use of huge excavators which turned out Rs. 1,000 worth of work in a day of 24 hours and saved the employment of 3,000 coolies for five years.

Advantage is taken, of the considerable head, at which water is let down for irrigation, to generate power with at least a portion of the water required for irrigation. To do so 4 sets of hydro-electric pipes each $8\frac{1}{2}$ feet diameter have been built into the dam and these

will operate with a head of water varying from 60 to 160 feet according to the storage in the reservoir. The plant will consist of 4 turbines one of which will be spare. About 33,000 H. P. with an average head of 125 feet can be generated. The estimated cost for developing hydro-electric power from the reservoir is Rs. 180 lakhs.

The industrial possibilities and potentialities of the Mettur Project are referred to in an illustrated pamphlet prepared by the Deputy Director of Industries about two years ago, with a view specially to invite the attention of manufacturers in India and abroad to the facilities, which will be afforded by Mettur on the completion of the Project in 1934, for the establishment of manufacturing industries and the setting up of mills and factories of various kinds.

A severe handicap in the past to develop industries in South India has been the high price and scarcity of fuel. With cheap electric power now made available by the project, and with labour and facilities for traffic Mettur would be the best suited site for starting new industries or for developing what were till now only cottage industries. With cheap electricity available it would be possible to provide greatly improved facilities for the development of rural tracts. Electric power can be used for sawing, fodder cutting, and grinding, rice hulling, groundnut decorticating, oil milling, cotton ginning, bone crushing, sugarcane crushing, sugar manufacturing, etc. Textile industries in the home such as cotton and silk weaving, hosiery-making, dyeing and stencil printing can be developed. Textile mills—cotton spinning and weaving mills—can be established or increased in number, thus making use of the raw cotton grown round about but now being exported for want of cheap power. There are also facilities for starting silk hosiery and dyeing factories. Another possible industry with reasonable prospects is the manufacture of vegetable fats by hydrogenation process, Mettur being in fairly close proximity to important trade centres and also to the West Coast. A factory here would thus be able to secure almost all kinds of vegetable oils. The availability of bamboos suitable for paper making from the forests round about, offers scope for establishing the pulp and paper industry. The exploiting of the iron beds in the Salem District, given up about 80 years due to heavy cost of fuel, can now be taken up with the availability of cheap electric power. Railways can be electrified.

The Mettur Dam as completed provides for:

(*a*) a dam across the Cauvery River at Mettur forming a reservoir of effective capacity 93,500 million cubic feet;

(*b*) a canal and distribution system taking from the right bank of the Cauvery just above the Grand Anicut to supply water to a new area of 301,000 acres with a second crop area of 84,000 acres in the Tanjore District;

(*c*) improving the water distribution and supply to the existing wet area in the Cauvery Delta of roughly 1 million acres and extending in this area the extent of double cropping lands by 70,000 acres;

(*d*) generating hydro-electric power which will provide better amenities of life and help the development of industries on large and small scales; and

(*e*) regulating the high flood discharges of the Cauvery to an extent which materially reduces the damage to the country south of the reservoir.

Extracts

AGRICULTURAL MARKETING SCHEMES IN GREAT BRITAIN.

Important developments are taking place in Great Britain and Northern Ireland in regard to the marketing of agricultural products. A system of marketing regulated by organisations to which the producers are compelled to belong was authorised by the Agricultural Marketing Acts of 1931 and 1933 and is gradually being applied to different products. The system may be regarded as a form of compulsory co-operation; a scheme of regulation under the Marketing Acts cannot be put in operation without the consent of a two-thirds majority of the producers concerned, but once it has been approved by the majority, it becomes binding upon all producers.

The Agricultural Marketing Act of 1931, which enables producers to form organisations for regulating the marketing of their product, applies to "Any product of agriculture or horticulture and any article of food or drink wholly or partly manufactured or derived from any such product and fleeces and skins of animals." This definition, it will be noticed, excludes any manufactured or derived product which is inedible. The producers contemplated by the Act are the direct producers of the product in question; in the case of a manufactured product, the producers who are to be enabled to regulate the marketing are the manufacturers, not the producers of the raw material.

The producers of any product may submit a scheme for regulating the marketing of that product. For the purposes of such a scheme the product may be a group of products, or, on the other hand, any kind, variety or other subdivision of a product. The scheme may apply to Great Britain as a whole or to any part of Great Britain, and the regulation contemplated applies to the marketing of the product produced in the area to which the scheme applies, wherever that produce may be sold.

Normally it is expected that the producers will submit schemes through the medium of their associations, but the Act provides for the appointment of Marketing Re-organisation Commissions by which schemes may be prepared. A scheme prepared by a Re-organisation Commission must be brought to the notice of the producers, who alone have the right to submit it.

A scheme affecting England and Wales or any part thereof is submitted to the Minister of Agriculture; a scheme affecting Scotland or any part thereof to the Secretary of State for Scotland, and a scheme affecting Great Britain to the two Ministers jointly. The Minister (or Ministers) must satisfy themselves that the persons who submit the scheme are substantially representative of the producers of the product concerned in the area to which the scheme is applicable. When the Minister is satisfied on this point, he must give notice of the submission of the scheme by publication in the *London Gazette* or *Edinburgh Gazette* and in other ways. Persons who wish to protest against the scheme can make representations to the Minister or lodge a formal objection; representations and objections will be considered by the Minister and, if necessary, a public inquiry will be held. The Minister may propose modifications to the scheme, but his proposals must be submitted to representatives of the persons submitting the scheme nominated at the time of submission. If the majority of these representatives refuse to accept the proposed modifications, the scheme cannot be proceeded with. If, however, the majority accept the scheme, the Minister, after first giving the Board of Trade an opportunity of considering it, must lay the scheme before Parliament. If a resolution of both Houses is passed approving it, the Minister issues a formal order. Before, however, the scheme comes into full operation it must be submitted to a poll of the producers affected by it. The manner of taking the poll is laid down in the scheme itself, but a majority of two-thirds of those voting (measured both in numbers and in output of the product) must be obtained before the scheme can be put in operation.

For the purposes of the poll and of the working of the scheme producers must be registered and a producer who fails to register cannot continue to sell the product unless specially exempted from registration. A scheme is ad-

ministered by a board of directors composed of representatives elected by the registered producers. There are three types of boards and each scheme will determine the type of board to be adopted for the product to which it relates. The three types are :—

(1) Trading boards, themselves buying and selling the regulated product and possibly engaged in manufacturing commodities from it.

(2) Regulating boards, undertaking no trading, but issuing instructions as to the methods and operations involved in marketing the product.

(3) Combined trading and regulating boards.

The powers which may be entrusted under a scheme to a marketing board are very wide, amounting, in fact, to a complete control over the marketing of all supplies of the regulated product produced in the area to which the scheme applies. If a trading board is contemplated, it may be given powers to constitute itself or its agents as the sole buyers of the whole of the regulated product or of any kind, variety or grade of the product. A regulatory board may be given powers to control the placing of supplies on the market, to restrict the sale to certain kinds, varieties or grades, to fix maximum or minimum prices to regulate the terms of sale, and to determine the agents of sale.

Speaking broadly, the expenses of administration of a scheme will be met by a levy on the sales of the regulated product, but powers are given to marketing boards to obtain credit from banks for capital expenditure and for marketing. Two special funds are also created, one for England and one for Scotland, out of which the Minister of Agriculture or the Secretary for Scotland can make either short term or long term loans to marketing boards.

Elaborate safeguards are introduced for the protection not only of the producers of the regulated product but also of the consumers. The Act provides for the formation of "Consumers' Committee" and "Committees of Investigation" for England, Scotland and Great Britain. The "Consumers' Committees" will watch over the operation of the various schemes from the standpoint of the consumer and report to Ministers. The "Committees of Investigation" will inquire judicially into matters referred to them by the Ministers.

A new Agricultural Marketing Act was passed in 1933, receiving the royal assent on 18th July. Its main purpose was to enable steps to be taken for regulating the supply of products in cases where such regulation might be necessary to enable the reorganisation of a branch of agricultural industry by a scheme under the Agricultural Marketing Act of 1931 to be fully effective. Power is given to the Board of Trade to regulate imports, and to the Ministers

responsible for agriculture to regulate the home output of any product which is the subject of an import Order. Provision is also made for the appointment of a Market Supply Committee to advise the Ministers in regard to the regulation of supply.

Another important provision of the Act is that it renders possible the organisation of the production of a manufactured product under a development scheme to be administered jointly by the marketing boards set up to organise the marketing of the manufactured product concerned and the primary agricultural product from which it is derived.

A short further Act was passed in 1933, the Agricultural Marketing (No. 2) Act, 1933, the principal object of which was to extend the powers of the Government to make loans to Marketing Boards and to enable one Marketing Board to guarantee the repayment of a loan made to another Marketing Board.

The Agricultural Marketing Acts of 1931 and 1933 do not apply to Northern Ireland, but an Agricultural Marketing Act has been passed by the Parliament of Northern Ireland which embodies the principles contained in the two British Acts. There is, however, a difference in the procedure adopted, since the Northern Ireland Act charges the Ministry of Agriculture for Northern Ireland with the duty of preparing schemes for regulating the sale of an agricultural product produced in Northern Ireland, and makes it mandatory on the Ministry to prepare a scheme whenever it is necessary to facilitate the working of a marketing scheme under the United Kingdom Acts. The effect of this will presumably be that whenever a marketing scheme is in force in Great Britain in respect of an agricultural product that is also produced in Northern Ireland, a complementary scheme will be put in operation in Northern Ireland.

The first scheme to be submitted under the Agricultural Marketing Act was a scheme for the marketing of raspberries produced in Scotland. It was, however, rejected by the raspberry-growers when a poll was taken.

A scheme for the marketing of hops was the first to be actually brought into operation. It was approved by a poll of hop growers. The scheme seems to have worked satisfactorily. All hops offered to the Hops Marketing Board by the registered producers were sold during the first season at an average price of £ 8-11s. a cwt. as compared with an average price of £ 5-11s. in the preceding year. But the increased price is not to be entirely attributed to the marketing scheme; market conditions were such that prices would in all probability have been substantially higher, even if the scheme had not been in operation. The sale of the 1933 hops began on 30th October with prices ruling considerably higher than in the preceding year.

The original hop marketing scheme has been amended with a view to preventing over-production. The amendments provide for a quota of hops to be allocated to each registered producer every season. For any hops that are in excess of a producer's quota for a given season and are sent to the Hops Marketing Board for sale in that season, the producer will receive payment only if there is any surplus after full payment has been made by the Board for all quota hops.

In 1932, at the request of the producers, the Government appointed two Marketing Reorganisation Commissions. One of these was instructed to prepare for the whole of Great Britain a scheme for regulating the marketing of pigs and pig products, and also to investigate the best means of operating a "quantitative regulation" of the imports of pig products. The other Commission was appointed to prepare a scheme for the marketing of milk in England and Wales, but without any instruction to investigate the regulation of imports.

The Reorganisation Commission for Milk presented its Report in January 1933 and in March the National Farmers' Union submitted to the Minister of Agriculture a scheme based on the recommendations of the Commission. After passing through its various stages, the Milk Marketing Scheme was finally approved by an overwhelming majority at a poll of milk-producers held early in September. Under this scheme England and Wales are to be divided into eleven regions, for each of which a regional committee will be elected by the registered producers in the region. For the whole country a Milk Marketing Board, also elected by the registered producers, will be constituted and the regional committees will advise the Board as to the working of the scheme in the different regions.

With certain exceptions, all milk producers will be obliged to become registered: if they fail to do so they will not be allowed to sell milk. The Board will have power to prescribe the form and the terms (including prices) of the contracts for the sale of milk by registered producers, and, in particular, they may prescribe as a term of the contract that the purchase price shall be paid to the Board. Prices for the sale of milk for liquid consumption may vary according to the different districts and prices for the sale of milk for manufacture may vary according to the purpose for which it is to be used. It is a fundamental principle of the scheme that the proceeds of all sales of milk wholesale by the registered producers of a region shall be "pooled" so that each producer shall receive a uniform price for his milk irrespective of whether it is sold for liquid consumption or for manufacture. In order to make possible an equitable adjustment of pool prices as between regions with a high and low proportion of sale for liquid consumption, a levy will be made on sales of liquid

milk and out of the fund so raised compensation will be given to producers in regions where the proportion of sales for liquid consumption is low.

The Board will be able to prescribe that registered producers shall be paid additional premiums for milk of special grades, for level deliveries, for special services or for guaranteed quality. These premiums will not be pooled, so that the producers who earn them will receive them in addition to the pool price.

For the first year of the operation of the scheme, the Board will be under the obligation, in fixing prices, to consult with the organisations representing distributors, manufacturers and other purchasers of milk by wholesale, together with not more than three persons nominated by the Minister of Agriculture. If the Board and the buyers do not come to an agreement, the Minister's nominees are empowered to fix the prices.

As early as June 1932 a Milk Marketing Scheme applicable to Scotland south of the Grampian Hills had been submitted by the Scottish Agricultural Organisation Society to the Secretary of State for Scotland, but it was not until September 1933 that it was finally approved by a poll of producers.

The Milk Marketing Board for England and Wales lost no time in bringing the scheme into operation. Already in October 1933 prices were fixed for milk and contracts were entered into.

In October the price of milk to retailers in the South-Eastern region (which includes the London metropolitan area) was fixed at 1s. 4d. a gallon. In all other regions the price was 1s. 3d. a gallon.

In the case of the "10 per cent variation contract," where the seller sending to the retailer, say, 100 gallons of milk is allowed to vary his supply between 90 gallons and 110 gallons, the seller was to get an additional $\frac{1}{2}$d. per gallon. Where milk was supplied on a "5 per cent variation contract," the additional allowance was to be 1d. a gallon.

The price of manufacturing milk varied according to the purpose to which it was applied. The prices per gallon were as follows:

Milk manufactured into butter or cheese or into condensed milk for export; the average price per maund for the previous month of the finest white Canadian cheese and the finest white New Zealand cheese, less a sum of $1\frac{3}{4}$d.

Milk manufactured into	condensed milk	...	6d.
,,	milk powder	...	6d.
,,	fresh cream	...	9d.
,,	tinned cream	...	6d.
,,	chocolate	...	8d.
,,	other products	...	9d.

For November the price of milk to retailers was fixed at 1s. 4d. for all regions. For December and January it was fixed at 1s. 5d. in the South-Eastern region and 1s. 4d. in other regions. In February the price was to be 1s. 4d. in all regions and in March 1s. 2d. in all regions.

For November and December the price of milk to be manufactured into butter and cheese or into condensed milk for export was fixed at 3¾d. per gallon the other prices of manufacturing milk remaining the same as in October.

In October the sales of milk by producers and product retailers exceeded 50,000,000 gallons, and payments amounting to over £ 2,150,000 were made to 67,000 whole producers.

Of the October milk, 16 per cent went to manufacturing; in November the proportion was 18 per cent. The average manufacturing price was 5s. 6d. in October, and 5s. 4d. in November.

Expenses were charged at the rate of ¼d. per gallon and included.—

(*a*) Expenses of the promotion of the scheme.

(*b*) Initial expenses, including the cost of the bill.

(*c*) Administration expenses of the Board, including a reserve for liabilities.

The inter-regional compensation levy was fixed at 1d. a gallon on all milk sold as liquid milk and 85 per cent of this levy was allocated to the regional pools in proportion to the quantity of milk sold for manufacture, the object being (as explained above) to equalise to some extent the prices between the different regions.

In addition to the inter-regional compensation leyy, producer-retailers have to pay a further levy on milk sold which varies, in accordance with a rather complicated calculation, with the regional pool price. The total payments per gallon made by producer-retailers ranged between 1d. and 1 15/16d. in October between 1s. 3/8d. and 2 1/8d. in November and between 1 3/16d. and 1 15/16d. in December.

The effects of the pooling system in equalising the prices in the different regions, notwithstanding the great differences in the proportions of milk sold as fresh milk and as manufacturing milk may be seen from the following table, which indicates the regional pool prices to the nearest farthing in October, November and December :

Region.	Regional Pool Price. October.	November.	December.
Northern	13¾	14	14½
North Western	13½	14	14
Eastern	14	14¼	14¾

East Midland	...	...	13½	14¼	14¼
West Midland	...	...	12¾	13½	14
North Wales	...	...	13¼	13¾	14
South Wales	...	...	13½	13¾	14
Southern	...	...	14	14¼	14¾
Mid Western	...	...	12¾	13¾	14¼
Far Western	...	...	13¼	13½	13¾
South Eastern	...	...	14¾	14½	15¼

The Scottish Milk Marketing Board started operations in the southern counties of Scotland on 1st December 1933, and fixed the producers' price for liquid milk at 1s. 2d. per gallon for the months of December, January, February and March. The prices for manufacturing milk were fixed at slightly lower rates than in England. The Scottish scheme affects about 8,500 producers.

The Reorganisation Commission for Pigs and Pig Products presented in October 1932 a Report containing draft schemes for regulating the marketing of pigs and bacon. Under the Agricultural Marketing Act 1931, while a scheme may be drafted by a Reorganisation Commission, it can only be submitted by an organisation representing the producers. Accordingly, in January 1933 a scheme for the marketing of pigs, based on the recommendations of the Reorganisation Commission was submitted by the National Farmers' Union to the Minister of Agriculture and to the Secretary of State for Scotland and at the same time a parallel scheme for the marketing of bacon was submitted by the Food Manufacturers' Federation. After passing through the stages of public inquiry into objections and of being laid before Parliament, the schemes were provisionally brought into force on 6th July 1933 by orders issued by the two Ministers. A poll of pig producers and a poll of bacon-curers were then taken, the results of which were declared on 9th August. Both schemes were approved by large majorities and became effective from September.

The Pig Marketing Scheme applies only to pigs sold for conversion into bacon; it does not regulate the sale of pork-pigs or store-pigs. The Bacon Marketing Scheme applies to all bacon and hams produced in Great Britain, including bacon and hams cured in Great Britain from imported live pigs and carcasses.

It is intended to insist that all sales of bacon pigs to curers shall be on contract. The Pigs Marketing Board set up under the Pigs Marketing Scheme has power to insist that producers shall only sell to curers under contracts registered and confirmed by it and the Bacon Marketing Scheme prohibits the

sale of bacon by registered bacon producers unless it has been manufactured from pigs purchased on contract from registered pig producers or from the Pig Board itself or from pigs produced by the curer himself, or from pigs or carcasses produced outside Great Britain. Under the contract system the bacon-curer will have his raw material guaranteed in advance and the pig feeder will know in advance the price he will receive. Even before the Schemes came into effective operation the Pigs and Bacon Boards had agreed on the scale of prices for the first contract period. The price will vary according to the cost of a standard ration of feeding stuffs. So long as the standard ration costs 7s. 6d. per cwt., every pig of standard quality will be paid for at the price of 12s. per score deadweight at the sender's station or collecting depot, the curer paying carriage. If the price of the ration varies, for every 3d. per cwt. of rise or fall, the price of the pig will rise or fall 3d. per score. The price will also be varied according to the weight and the quality of the pigs.

The first contracts under the Pigs Marketing Scheme were for the period 1st November 1933 to 28th February 1934. The number of pigs which the producers contracted to supply was unexpectedly large, being no fewer than 620,000. Adding to these figures the output of Northern Ireland, these figures represented a rate of bacon production in the United Kingdom of about 3,000,000 cwt. per annum, whereas it had been calculated that the production would be only 1,750,000 cwt.

This rapid expansion of the home industry raised doubts as to whether it would be possible for the bacon-curers to dispose of so large a quantity of home-produced bacon without so far lowering the prices as to incur losses. In view of this risk, it was agreed that the Government should make a loan to the Bacon Marketing Board to enable it to compensate the bacon-curers for any losses incurred, and that the repayment of the loan should be guaranteed by the Pigs Marketing Board. To make these operations possible the Agricultural Marketing (No 2) Act, 1933, was passed.

Before it was known that the supply of home-produced bacon would be so largely increased by the working of the scheme voluntary agreements had been entered into with the principal foreign countries exporting bacon whereby these countries would reduce the quantities of bacon consigned to the United Kingdom, but it became apparent that a much more drastic reduction was necessary. It proved impossible to obtain this reduction by voluntary agreement and accordingly an Order was issued by the Board of Trade on 7th November 1933 prohibiting the importation of bacon (including hams) except under licence from any country which exports more than 400 cwt. a week to the United Kingdom. The Order came into operation on 1st December 1933, and for the period 1st December 1933 to 28th February 1934 licenses were issued on the basis of a

total importation from foreign countries of 1,979,330 cwt. this total being allocated amongst the supplying countries. The extent to which imports of bacon were restricted may be judged from the fact that the total imports from 1st December 1932 to 28th February 1933 were 2,561,459 cwt.

A Potato Marketing Scheme, applicable to the whole of Great Britain was submitted to the Minister of Agriculture and to the Secretary of State for Scotland by the National Farmers' Union and the National Farmers' Union of Scotland and, after a protracted public inquiry, was finally approved by a poll of producers held on 5th February 1934. This scheme is on somewhat different lines from the other marketing schemes mentioned. The aim of the scheme is to withdraw from sale for human consumption the quantity of potatoes regarded as surplus to the requirements of the country in any year. It is proposed that this should be done by fixing from time to time the minimum riddle size of potatoes which it was permissible to sell for human consumption. The surplus potatoes will probably be used chiefly in stock feeding on farms, but the Potato Marketing Board will have power to develop other outlets, such as the manufacture of alcohol and farina. To ensure that the cost of disposing of additional surplus potatoes caused by excess planting is shared by those responsible the Board may demand a special contribution to its funds from registered producers who plant more than the "Basic acreage" fixed for him on lines prescribed in the Scheme.

The Minister of Agriculture has appointed a Reorganisation Commission to prepare a scheme for regulating the marketing of fat stock in England and Wales, and the Secretary of State for Scotland has vested the Scottish Agricultural Organistation Society with the powers of a Reorganisation Commission for the purpose of preparing a scheme for regulating the marketing of fat stock in Scotland. Reorganisation Commissions have also been appointed to prepare schemes for regulating the marketing of eggs and poultry in England and Wales and in England respectively, and it is proposed to appoint, from the personnel of the English and Scottish Commissions, a Reorganisation Commission for Great Britain whose duty it will be to investigate and report on the manner in which the operation of the schemes prepared can be facilitated by co-operation between the Boards administering them and any corresponding body in Northern Ireland and by the regulation of imports of eggs and poultry and other products. (*The Inter. Review of Agriculture, March 1934.*)

AGRICULTURAL RESEARCH. *

BY THE RT. HON. W. ORMSBY-GORE, M.P.

Success or failure in agriculture, as in every other art or industry, depends on "comparative efficiency". The farmer succeeds or fails in proportion as he produces the better article, and produces it more economically than his competitor producing a similar article. The better quality product, produced in greater quantity to the acre beats the inferior and less "economic" product off the market. And, as in industrial production, the race is never won. It is continuous and everlasting. Every day the research worker is breeding more efficient plants, is breeding and feeding a more economic domestic animal—success is to those in the vanguard of this perpetual progress: failure to those that lag behind. We cannot afford to resist this law of change or disregard the ever-expanding discoveries of the scientific worker.

Organised agricultural research has usually begun as defence against plant and animal disease. Some pest or fungus attacks a crop and we seek the help of the bug hunters (entomologists) and mould fighters (mycologists) to protect our crops from these attacks, just as we go to a doctor when we are ill. Now, just as "preventive medicine", sanitation, etc., is seen to be more important than the cure of pathological conditions, so, in agricultural research, the best protection of plants and animals against disease is a robust constitution, and disease-resistant factors, which can be bred or maintained by special feeding.

The bulk of the higher modern agricultural research work in the world has developed into three main types of scientific effort—the work of the geneticist or breeder, the work of the physiologist, and the work of the nutritionist or feeder. Perhaps I ought to add the "ecologist" the man who studies the environment of a plant or animal and seeks to establish what are its optimum conditions of climate, soil (in the widest sense), light supply, etc. Of course, the process of "seed selection," cross-breeding of animals, manuring of plants and special feeding of domestic stock, have always gone on in agriculture. But, nowadays, these often chancy or empirical advances of the past have been superseded by the more scientific, fundamental and long-range research of the geneticist and the nutritionist.

The agricultural research stations which seem to be making the most remarkable advances in new discovery to be leading in the race for agricultural efficiency are those "one crop" stations, where a team of specialist

* *The Journal of the African Society, January 1934.*

workers concentrate on the improvement of the economic efficiency of one crop. In them with the geneticist leading the plant physiologist, the biochemist, the ecologist, the entomologist, the mycologist, set out to solve problem after problem with a view to producing new types and new varieties of greater economic efficiency than the existing ones, and of controlling or supplying the (often obscure) environmental conditions under which that efficiency can best be realised.

The scale and range of some of these stations is enormous, including as they do, not merely the creation of new varieties, but all the problems of manuring, irrigation, and improved technical handling of the crop. Probably the largest and in many ways the most remarkable, are the new sugar beet and potato research stations in Soviet Russia. In the tropics, the research stations in Java, and especially the great sugarcane research station at Passaruan, are the most up-to-date and successful.

What both Governments and farmers frequently fail to realise is that we have now reached a stage of knowledge and experience in these matters where the making of further advances, as regards many of the world's staple crops, involves the organised team work of many specialists over a series of years. The demand of the layman is for quick results for expenditure in research. This demand is often quite impracticable, and its mere existence has often diverted the team of workers from what they know to be the better, and utlimately more useful, but longer, piece of work, in favour of something shorter in time, but less important in result. For there must be no misunderstanding that the most important advances are nearly all the result of uninterrupted work on a problem for anything from five to ten years.

Research is necessarily expensive. Not only is the whole apparatus of the agricultural research worker a fairly expensive business, but the worker himself has nowadays to go through a long period of university and post-graduate training, and, in order to keep up-to-date, has to be fed with literature and translations from contributions by other workers in the field in many different languages. And, above all, the supply of the really qualified men is pretty limited. There is somewhat of a vicious circle at present in this last matter. There are few men beeause there are few jobs offering. On account of the world-wide commodity slump, at this moment there are more men capable of good research work than there are jobs at any rate in the British Empire overseas, a strange contrast to conditions obtaining a few years ago.

It is not easy to bring home to the average citizen of the British Empire, with his general and most universal tradition of literary and classical education,

the significance of modern science. Even where he has included in his education some smatterings of modern science, his knowledge in the main is linked to physics and chemistry. For most British people biology is either a closed book or limited to a little botany or zoology. Some decimal of one per cent may have heard of Pasteur, a smaller decimal of the Abbe Mendel. Genetics—even plant genetics—is still something under taboo as a school subject. Consequently the politician and the administrator, the treasury controller and the general public don't begin to know what the agricultural research worker thinks about. They don't begin to comprehend his language, still less to understand the character of his work. This ignorance is a serious danger to the whole economic future of those parts of the Empire that are dependent on agriculture, and particularly on the export of agricultural products in competition with world markets. We are skilled in handling legal, transport and industrial problems, but tiros at modern biology. Our research institutions in the Colonial Empire are few, small and short of money and personnel. The few we have are good, especially the College and the Cotton Research Station in Trinidad. Trinidad in a few short years has already made a real difference: but we are behind the vanguard in the race and we cannot henceforth afford to leave it to the Dutch, the Russians and the Americans to lead us. We are already suffering in competition from a want of knowledge and a want of intelligent imagination in this whole subject. Our whole educational curricula have been based on an old stable civilisation and on conditions that are fast changing. The most serious gulf to be bridged is the intellectual gulf between the actual research worker and the people with power who alone can provide him with the support and opportunities, without which the research worker cannot help them.

WORKING OF THE DEPARTMENT OF AGRICULTURE, CENTRAL PROVINCES, 1933-34.

(Resolution of the Local Government on the working of the Agriculture Department).

In spite of the heavy retrenchment already effected in the staff, signs of progress were in evidence in all the principal activities of the Department of Agriculture during the year 1933-34. The number of seed farms was 18,843 (17,274) and the quantity of pure seed distributed was 464,834 maunds (445,413 maunds). The increase is a welcome indication of the growing appreciation on the part of agriculturists of the superiority of improved seed and of their readiness to find money for it even with their reduced resources. The approximate

area sown with improved seed was 1,693,812 acres (1,602,211 acres) and the value of the increased outturn resulting from the use of the seed is estimated at Rs. 54.08 lakhs (Rs.51.78 lakhs). There was no falling off in the work of propaganda and demonstration and the number of practical demonstrations carried out increased considerably. The slight reduction in the number and value of improved implements sold was inevitable during the present depression. The institution of "farmers' days" on the Government farms and demonstration plots in Chhattisgarh and Berar is a happy idea; and Government hopes that this method of bringing large numbers of farmers into closer touch with the activities of the Department will be used more extensively.

2. Research work continued on well established lines and Government is pleased to note that the botanical section is within sight of giving to the growers of wheat improved strains which, in addition to being more productive, will free them from the losses caused by rust. The cultivation of linseed has received an impetus from the Ottawa Agreement, and as the Central Provinces is the largest grower of this crop in India, every effort should be made to obtain for the grower in this Province a share of the increased trade. This can only be done by the replacement of the present poor yielding varieties by higher yielding and rust resistent types. Government is pleased therefore to note that extensive and intensive trials are being conducted by the Department, and trusts they will bear early fruit.

3. Cotton remained in the forefront of the research programme of the Department. Government has read with interest that new strains of *verum* have been developed which are expected to stand up to more adverse weather conditions, and hopes that the results will be consolidated. It is also gratifying to note that the scheme for the marketing of *verum* cotton continues to work successfully, and that it put into the pockets of the growers who participated in the scheme an additional income of Rs. 1½ lakhs. This scheme has certainly passed the experimental stage and its success and possibilities have been demonstrated beyond doubt. Government hopes that private organizations will now take over this work and extend the area of its operations so that all cotton growers may receive their due share of the final price of their produce. On the recommendations of the Indian Central Cotton Committee a scheme has been accepted for a large extension of the area under *verum* cotton, which will widen the market for Central Provinces cotton and make it more independent of a single main purchaser. Government has, however, read with concern the remarks of the Director on the adulteration that has begun to take place with *verum* cotton, and trusts that all who have the welfare of the cotton grower at heart will set their face against the practice and do everything in their power to discourage it.

Government will watch with interest the course and results of the propaganda for the further extension of the cultivation of groundnut, particularly, as a rotation crop in the cotton tracts. The new rice research scheme is working in full swing.

4. Government fully realises that the maintenance of the present level of activity and efficiency in carrying out the demonstration and research work has been rendered possible by the special staff financed from funds provided by the Indian Central Cotton Committee and the Imperial Council of Agricultural Research. Government records its gratefulness to these bodies for their assistance and is pleased no note that several fresh research schemes have been submitted to them. They deal with problems the elucidation of which is calculated to add considerably to the prosperity of the cultivators.

5. The Agricultural College had a successful year. Its passed students included several from other provinces and Indian States, and the utility of the institution has begun to extend beyond the boundaries of the province. Government trusts that the proposal pending before the University for instituting a post-graduate degree for research in agriculture will serve as stimulus to specialization. The various other concessions by virtue of which the degree of the college will cease to be the blind alley it has been felt to be, should attract students with the best calibre to agricultural education and it is hoped more of them will now make practical use of the knowledge they acquire.

6. Much credit is due to all ranks of the staff who by their intensive efforts have partly made up for the curtailment in the strength of the Department. Mr. Plymen retired during the year after a distinguished career, and Government reiterates the tribute paid to him in the resolution of the previous year. It also records its appreciation of the initiative, vigour and enthusiasm with which Mr. Ritchie, the new Director, has set about his duties. (*Central Provinces Gazette.*)

Gleanings.

Crop Planning in India.—The crop planning sub-committee of the Advisory Board of the Imperial Council of Agricultural Research has arrived at some interesting conclusions. As regards rice it was agreed that there is no overproduction either in India as a whole or in any part of it. The committee, however, passed a resolution that in view of the present world conditions in the matter of rice production no provincial Government should ordinarily offer any stimulus to an increase in the present area under rice.

As regards wheat the conclusion of the sub-committee was that there is no overproduction at present. But in view of the world position in wheat and the possible danger of overproduction they recommended that no stimulus should be given to the expansion of wheat cultivation in India. The sub-committee did not make any recommendations regarding cotton and jute since these problems are being carefully considered by special committees appointed by the Indian Central Cotton Committee and the Bengal Government respectively. It was found that there was no need for placing restrictions on the cultivation of groundnut and the sub-committee recommended that the Government of the United Kingdom be approached with a proposal to impose an import duty on all foreign fats, oils and oil-seeds which compete with oil-seeds produced in the Empire. The position of castor seeds was found satisfactory and there was room for development rather than for its restriction. There was great need for extending the cultivation of linseed in India especially of the improved and resistant varieties. The sub-committee was unable to make any specific recommendations regarding the maximum sugarcane area on account of the insufficient knowledge of the production and consumption of *gur* in India. But the area under cane in India is not so large as to affect the general question. There was ample scope for an expansion of the area under tobacco, particularly of the light bright varieties suitable for cigarettes. The following general recommendations were made in regard to the provinces. Madras could increase its area under Combodia cotton and sugarcane by 50,000 acres each. Bombay could increase its area under sugarcane, mangoes, pine-apples and plantations. Bengal could increase its area under sugarcane and fodder crops. United Provinces could increase its area under linseed and barley. The Central Provinces could increase its area under linseed and groundnut.

Sodium Chlorate Weed-Killer.—Home gardeners as well as farmers and horticulturists will be interested in recent successful experiments with sodium chlorate as a weed-killer. Tests have been carried out by several different experimenters working independently, and all agree that the treatment is both effective and cheap. Chemical Industries reports that tests carried out at a temperature of 40 degrees Centigrade, and soil humidity of 24 per cent show that the toxicity of sodium chlorate in the soil sinks to nil at the end of six weeks, while in a fresh and relatively dry soil the salt maintains its toxic properties for more than two years. Results in the wet soil are due to the decomposition of the chlorate with the liberation of oxygen and the production of sodium chloride. It has also been tried out in cereal cultivation in the endeavour to secure a comparison with sulphuric

acid, with the finding that the chlorate process is more economical than the sulphuric acid, and easier to use. From other literature it appears that that a 10 per cent solution (one pound per gallon of water) is required for the eradication of large grasses and docks; a 5 per cent solution for herbaceous weeds and small grasses, while small annual weeds require a $2\frac{1}{2}$ per cent solution. (*Scientific American.*)

Land for the Educated Unemployed.—It is understood that as a preliminary to the scheme for settling educated young men on land, and as a means of checking the growth of unemployment amongst the educated classes, the U. P. Government have finally decided to utilise part of the Fyzabad Government Farm for establishing a practical training centre for ten persons. In order to demonstrate the relative advantages and disadvantages of individual *versus* collective farming, five settlers will be given consolidated blocks of ten acres each and the other five will be assigned fifty acres jointly between them and will be required to pool their income and divide it amongst themselves. The training will last three years and various facilities will be provided. (*The Hindu.*)

Agricultural Debt-Redemption in Bhavanagar State.—Bhavanagar State has provided, says the *Financial News*, an object lesson for other States and British provinces in the scheme of agricultural debt-redemption, for which Sir Prabhashankar Pattani was mainly responsible. It has brought to light the worst evils of moneylending and indebtedness and the peasants, groaning under various types of exactions, have not revolted against the moneylenders and the legal system which supports them, because they are not naturally fighting men. Yet there is a great deal of unrest which is now noticeable in many parts of the country. In Bhavanagar, the Durbar paid early attention to the difficulties of the agriculturists and lost little time in putting into execution a scheme recommended by a committee appointed to investigate the causes of and remedies for the permanent state of indebtedness into which the agriculturists had drifted. The liabilities of the cultivators were investigated and in each case they were compounded, the moneylender receiving from the State a cash payment which, though it was not the full amount of the debt, was certainly better than nothing; the agriculturists, on the other hand, became indebted to the State up to the value of the sum paid by the Durbar to the moneylender which is not much more than the annual interest charge. The cultivator now has the chance of beginning again with a clean slate. The importance of a measure of this kind can hardly be exaggerated. It is reported that as a result of the scheme of debt-redemption, the courts are singularly free from suit or executions pending against any cultivator. Litigation is always a source of

anxiety and expenditure. Moreover, the peasants have been saved many times the principal of their debts by the saving in interest, for, the ordinary rate of the sowcars appears to be 25 per cent while the dishonest practice of manipulation of accounts, demanding payment in kind at a loss of 50 per cent in prices from the cultivator or taking promissory notes in duplicate and demanding payment for both, are destined to come to an end. The history of the co-operative movement has shown decisively that it is useless to expect the cultivator either to become a good co-operator or to get rid of his debts so long as he is subject to pressure upon his resources of the old debts which grow faster than his capacity to repay them. It may be hoped that the lead given by Bhavanagar will be followed in other parts of India. (*The Mysore Economic Journal*).

Soft Teeth and Cereals.—The results of research conducted for the (British) Medical Research Council by Dr. Mellanby, and published by His Majesty's Stationery Office, London, suggest that if cereals are to be fed to infants, plenty of Vitamin D must also be fed. An abstract of Dr. Mellanby's Special Report No. 191, Diet and Teeth, contained in *Nature* (London) states that: "the main conditions responsible for immunity from dental decay are prolonged breast-feeding with a supplementary diet often for three or even six years and a high intake of Vitamin D (or exposure of the body to the sun) together with a sufficiency of calcium and phosphorus. A high carbohydrate diet (cereals or potatoes) is compatible with good teeth, provided the supply of Vitamin D, calcium, and phosphorus is also sufficiently great. Caries is especially rampant where cereals form a large part of the diet; breast-feeding is short; the intake of milk, eggs, and animal fats is small; and sunshine is negligible or rendered ineffective by clothing. It has thus been shown that perfectly calcified and regularly arranged teeth can be produced by including in the maternal diet during pregnancy and lactation, and in the diet of the offspring at the time of dental development, substances containing much Vitamin D, calcium and phosphorus, such as milk, eggs, fish and animal fats and that cereals, especially those rich in embryo such as oatmeal, tend to produce hypolastic teeth and call for a correspondingly larger supply of calcifying foods for good development. It has further been established that the resistance to caries can be increased independently of the original structure by giving a diet containing much Vitamin D, calcium and phosphorus, or decreased by a diet rich in cereals. (*Scientific American*).

By-products of Wheat.—Only the surface of the possibilities of extracting valuable by-products from wheat has been scratched, according to Dr. W.

Boyd Campbell, a Montreal chemist associated with the Forest Products Laboratories. Dr. Campbell called the attention of Canadians to the fact that the Chinese, by an ingenious method, had succeeded in extracting a substance which he called "monosodium glutamate" from wheat. The Chinese, Dr. Campbell continued, sell from one to two million dollars worth of the substance annually. Monosodium glutamate, he explained, is used by housewives and chefs as a condiment for imparting a meat-like flavour to vegetable dishes. Since there are many vegetarians in Asia from religious and other considerations, Dr. Campbell stated, the use of such a condiment is widespread. As a flavouring agent monosodium glutamate is described as being fifteen times stronger than cane sugar and seven times stronger than salt. Wheat worth two cents a pound was the raw material, in this way, for a substance worth from 2 to 3 dollars a pound, he added. "If Canada were to spend a small fraction of the money used to provide transportation for wheat for research work into valuable by-products, I believe that the wheat surplus would in time become a forgotten bogey." *(The Hindu)*.

Sugar from Wood.—It was known for a long time that sugar could be produced as a by-product of wood-alcohol or methylated spirit. But it was never attempted on a commercial scale. That this method is now being adopted for manufacturing sugar on a large scale in a recently completed factory at Mannheim-Rheinan in Germany was revealed by Dr. Friedrich Bergums at a meeting of the Institution of Chemical Engineers at London. This synthetic sugar is now being used only for feeding cattle and pigs. But with slight improvements in the process it could be made suitable for human consumption. This is an important step as most countries can now make sugar and thus become independent as regards an important item of food-supply.

Current Research

The Role of Field Drainage in removing excess water from the soil: Some observations on rates of flow from outfalls: by Nicholson, H. H. (*The Journal of Agricultural Science, Volume XXIV, Part 3, July 1934; page 349*). Some records of tile drain performance by J. Bailey Denton in 1856-7 have been re-examined. The different aspects of drainage in heavy and light-soil types are indicated. The existence and influence of the movements of the water table in connection with the behaviour of light-land drains are demonstrated. The problem of the water table in heavy land is discussed and the behaviour

of field test holes in such circumstances is explained by surface drainage into them. The magnitude of the fluctuations in run-off from heavy land and the need for closer records of outfall performance are stressed. Observations on the behaviour of mole drains on heavy clay land are described. Comparison of grass and arable land records reveals differences analogous to those between heavy and light land. An account is given of the effects of the advance of the drainage season and of the distribution of rainfall within the season. The nature of the differences in action of tile and mole drains is described. The effects of variations in the agricultural treatment of one soil type on its drainage properties are indicated. Examples are given of the drying out of the soil and subsoil in the absence of a soil mulch, of the power of surface-cultivations to keep the subsoil moist, and of the influence of cultivations in drying out the surface soil, together with their effects on the subsequent drainage history of the area involved. (*Author's summary*).

Studies on the Microbiology of Grassland Soil. Part 1. General Chemical and Microbiological features by Eggleton, W. G. E. (*The Journal of Agricultural Science, Volume XXIV, Part 3, July 1934, Page 416*). Pasture soil was found to be characterised by relatively high ammonia and low nitrate-nitrogen content during the main growing period (May-September). Applications of sulphate of ammonia while initially raising the ammonia and nitrate-nitrogen levels, ultimately led to a lowering. The effect of irrigation during the spring, when the soil moisture content was high, was to depress the ammonia and nitrate-nitrogen levels, but during the dry summer months and subsequently the levels were appreciably raised. A small though definite periodic change in the reaction of normal grassland soil took place during the season, the soil being most acid during the summer. Added sulphate of ammonia slightly accentuated the change, and the return to normal in the autumn was not quite attained. Bacteria and actinomyces were present in much greater numbers (50-60 millions/gm. dry soil) during the period April-May than at any other time of the year. The numbers were depressed (10-20 millions) during the hot summer months, owing to the lack of moisture, but increased again (30-40 millions) with the moist soil conditions in September. During the winter the numbers fell to approximately the summer levels. The fungal counts, on the other hand, were much higher in the autumn than in the spring. There were thus two well-defined periods of microbiological activity: April-May and September-October, corresponding to the two flushes of growth on grassland. Although numbers of bacteria and actinomyces were depressed during summer, the latter appeared to be relatively more tolerant of dry conditions, in that their proportion increased at this time. Lack of moisture in the summer was

accompanied by an increase in the number of fungal spores, but a decrease in the number of actinomyces spores. The effect of nitrogen added in the form of sulphate of ammonia, on numbers of bacteria and actinomyces, is small in comparison with the marked influence of moisture and temperature. During the relatively dry summer months, irrigation maintained numbers of bacteria, actinomyces and fungi at a definitely higher level. The evidence so far available indicates that in grassland soils the up-grade and down-grade processes of the nitrogen cycle are no different in nature from those in arable soils, but the level of intensity of these processes is higher. Owing to the different conditions in grassland soils—especially the plentiful supply of organic matter derived from the dense mass of roots and herbage debris—the population of micro-organisms is greater and the fluctuations in their numbers are more rapid and intense. *(Author's summary)*.

Survival of Cane Borers in Trash by Hinds, W. E. (*Int. Sugar Journal, Vol. XXXVI, No. 423, 1934, page 119*). While this major pest of the sugarcane may pass the winter in corn stalks, Johnson grass, or even rice stubble, its main shelter is the trash left on the cane fields at harvest. Control of the pest is therefore largely a matter of disposing of the trash in one of three ways : by drawing it into the low middles where it will be flooded and the living borer stages drowned ; by turning the trash out of sight in the soil ; or by burning. The latter method is to be recommended, provided the trash is sufficiently dry to get a good burn. It is not thought that burning the trash has any serious effect on the egg parasite *Tirchogramma minutum*.

Variations in Mineral Content of Cane with Age and Season by A. Ayres *Int. Sugar Journal Vol. XXXVI, No. 425, 1934, page 198*). The ash content of cane varies greatly with different varieties, and in the same variety according to age, season, climate and soil. Numerous analyses made on H 109 show that young cane, taken as a whole, contains relatively more ash (on a percentage basis) than mature cane. Between the ages of one and three months the content of phosphoric acid and potash in the dry matter of the leaves decreases by approximately 40 per cent, that of magnesia rises by some 35 per cent, lime by 145 per cent and silica by 175 per cent. The composition of the stalk in the vicinity of the growing point (top six inches) is very different from that of any other part of the plant. While ash content in remote parts of the plant is in the neighbourhood of one per cent it runs as high as 12.5 per cent of the total dry matter of the growing point. Here are to be found the highest concentrations of nitrogen, calcium, magnesium, phosphorus and potassium ; nearly half is potash. As we pass down the stalk we find that the proportion of potash rapidly decreases at first and

then more slowly as the base of the stalk is approached, whereas in this part the proportion of silica and phosphoric acid increases.

Rotation in the Tropics by C. Wood, (*Tropical Agriculture, Trinidad*, Volume XI, 1934, page 44). Primitive systems of agriculture are concerned almost exclusively with mixed cropping. In primitive communities the peasant has to grow all his own needs and provide food for his folk and his cattle, clothing and building materials. Pure crops are only exceptional, such as *Cajanus indicus* and groundnuts. Even where more advanced farming systems have adopted a regular rotation and the crops are drilled, the system of mixed cropping may persist. In the groundnut area of Madras, for example, it is a common practice to plant groundnuts in a crop of millet at the time when the latter crop receives its first weeding, when it is 18 to 24 inches high. There may be good reasons for growing mixed crops. Where it is desirable to protect a newly planted crop either from the wind or from the excessive heat of the sun, quickly growing shelter crops may be planted. And it is all the better if the shade plant supplies also a useful product. Such a practice is illustrated by the planting of bananas or root-crops to shade young cacao. A mixture of long and short term rices is sometimes grown in Southern India. When the early crop is ripe, the whole is reaped, and with further irrigation the shoots of the immature rice sprout again and produce what is really a second crop, though the peasants maintain that it is only a single crop in order to pay a single water rate. The chief disadvantage of mixed cropping lies in the expense of harvesting, because if the crops have to be kept separate this cannot be done with machinery. The advantages of a rational rotation are always better realised by the farmers of the tropics. Experience has taught them that crops exist which can act as a soil restorative and serve as good preceders for other crops. Continuous pure cropping is quite exceptional. Exceptions are rice, which is almost universally grown year after year on the same land with no rotation crop, and sugarcane in Trinidad. What are the principal rotations followed and which can be recommended to farmers? The simplest is crop, fallow and then crop again. Or there may be two crops between the fallows: cereal, legume, and fallow. This is a rotation which occupies many thousands of acres in Southern India, where the cereal is sorghum and the legume chickpea. The writer cites as an example of the bad effects of growing the same crop year after year without rotation, the maize growing in Southern Rhodesia. The Salisbury Experimental Station has shown by an experiment carried on over 16 years the following striking results :—

Crop.	Average yield of maize in lbs. per acre.	Acreage under maize out of 1000 acres.	Total crop (2000 lbs. bags)	Cost per bag in shilling.
(1) Maize every year ...	1118	1000	5940	5.3
(2) Maize and fallow ...	2178	500	5445	4.1
(3) Maize, Stizolobium, oats (no manure) ...	3044	333	5073	1.9

A rotation from Iraq illustrates double cropping for it comprises three crops in two years: cotton, March to October; cereal, November to May; legume, June to March. Nigeria provides a somewhat similar rotation and illustrates also the practice of starting a crop before the preceding one is off the land: maize, September to February; yams, planted in the maize, November to September; maize, planted through yams, March to August; cotton planted through yams and maize, August to February; maize, March to August; cassava planted through maize, May to January; then fallow for a number of years. The writer then gives a brief summary of the results obtained by the Imperial College of Tropical Agriculture. It was desired to check the practice of shifting cultivation and to find a rotation adapted for regions where the 'tsetse' prohibits the keeping of cattle, so that a legume crop is necessary. At first 8 crops were chosen for a period of 4 years:—(1) Stizolobium followed by maize; (2) soya bean followed by tobacco or cotton; (3) Stizolobium followed by sweet potatoes; (4) maize followed by cowpeas. The experience of the first three years showed that the land could not carry as much as this, and with the addition of potash and phosphoric acid the experiment is now testing the maintenance of nitrogen fertility only. The fallow periods when the soil is left uncovered are wasteful of fertility in the tropics because of the heavy rainfall, and arrangements are being made that when there is to be a fallow period of over a month a cover crop of *Phaseolus aureus* or *Crotalaria juncea* is to be sown. In the tropics there is a wide choice of plants that can enter into the rotation, and the most suitable sequence deserves considerable study. Experiments such as that carried out at Salisbury should be widely repeated in other localities. *(International Review of Agriculture year XXV, page T-273, 1934).*

Crop Forecasts.

First Forecast 1934-35.

SUGARCANE

All-India.—This forecast is based on reports received from Provinces and States which contain, on an avarage, 95 per cent of the total area under sugar-cane in India. The total area planted with sugarcane this year is estimated at 3,409,000 acres, as against 3,353,000 acres at this time last year, or an increase of 2 per cent. Weather conditions at the time of planting were favourable, and the present condition and prospects of the crop, on the whole, are reported to be good.

Central Provinces and Berar.—(0. 8 per cent). The area is estimated at 28,000 acres, as against 29,000 acres, the corresponding area of last year. There was sufficient moisture in the soil for sowing and light showers were received occasionally during the hot weather. The regular monsoon set in by the third week of June and the rainfall so far has been generally sufficient. The crop is in a satisfactory condition and prospects are hopeful.

Sugar in Foreign Countries.—From the latest information received from the Sugar Technologist to the Imperial Council of Agricultural Research, India, Cawnpore, it appears that the world's production of sugar, both cane and beet, in 1933-34, is estimated by Messrs. Willett and Gray at 25,452,000 tons (16,874,000 tons of cane sugar and 8,578,000 tons of beet sugar), showing an increase of 1,311,000 tons (358,000 tons of cane sugar and 953,000 tons of beet sugar) as compared with the preceding season. In Cuba, where the 1934 crop campaign is nearing completion, the final production is expected to be better than last year and is placed in the neighbourhood of 2,250,000 tons. In Mauritius, the 1933-34 sugar crop is now placed at 265,000 tons. The prospects for the coming crop are considered to be fair although rainfall is deficient. In Java, the outturn of the 1935 crop has been fixed at 450,000 metric tons (443,000 tons) on an area of approximately 28,000 hectares (69,000 acres), as compared with 590,000 metric tons (581,000 tons) on an area of 35,000 hectares (86,000 acres) in 1934 and 1,401,000 metric tons (1,378,000 tons) on 85,000 hectares (210,000 acres) in 1933. In the Philippines, the 1933-34 sugar crop will approximate to 1,600,000 short tons (1,429,000 tons), raw value. (*The Indian Trade Journal*).

COTTON

All India.—This forecast is based upon reports on the condition of the cotton crop at the end of July or early August. The reports do not relate to

the entire area of India but to only 77.5 per cent of the total. The area sown is at present estimated at 12,985,000 acres, as compared with 13,999,000 acres (revised) at the corresponding time of last year, or a decrease of 7 per cent. The decrease is attributed to decline in area in the Hyderabad State owing to unfavourable conditions at sowing time. Weather conditions were not favourable for sowings in the important cotton-growing tracts, viz. Bombay, and Hyderabad owing to deficient rains ; but elsewhere, sowings were generally made under favourable conditions. The present condition of the crop is, on the whole, reported to be fair.

Central Provinces and Berar.—(19.2 per cent). The area sown is estimated at 4,303,000 acres (2,902,000 acres being in Berar), which is 2 per cent above the corresponding area of last year. Light rain fell in the first half of June but the regular monsoon set in by the third week of the month. It strengthened towards the close of the month, giving moderate to heavy rain all over the province till about the middle of July. Thereafter a break set in for about a week which afforded time for weeding and harrowing operations. Since then, there has been good rain at intervals everywhere in the province. Sowings were made under favourable conditions and germination was satisfactory. Some re-sowing was, however, necessary in parts of six districts owing to heavy rain soon after sowing. The present condition of the crop is good and prospects are hopeful.

Cotton in Foreign Countries.—From information specially obtained from the United States Department of Agriculture, Washington, it appears that the area of cotton in cultivation in the United States of America during the current year is estimated at 28,024,000 acres, and the production of the crop is at present estimated at 9,195,000 bales of 500 lbs. each (equivalent to 11,494,000 bales of 400 lbs. each), as compared with 13,047,000 bales of 500 lbs. each (equivalent to 16,309,000 bales of 400 lbs. each) the revised final estimate of 1933. In Egypt, the area planted to cotton this year is estimated at 1,798,000 acres, as compared with 1,873,000 acres last year. From the latest available bulletin published by the International Institute of Agriculture, Rome, it appears that the production of the cotton crop of Anglo-Egyptian Sudan for 1933-34 is estimated at 173,000 bales of 400 lbs. each, as compared with 145,000 bales in the preceding season. In Uganda, the production of the crop for 1933-34 is now estimated at 272,000 bales of 400 lbs. each, showing a decrease of 6 per cent as compared with the preceding season. (*The Indian Trade Journal*).

Calender of Operations

FLOWERS

By R. N. Sinha.

August.—Seeds for cold weather use may be ordered during this month. Any of the following seeds may be ordered according to one's choice. When the seeds have been received they should be kept in air-tight tins, bottles or boxes till they are required for sowing :—

Gypsophilla ...	... Astor
Gereniums ...	... Anterrihinum (Snapdragon)
Helichrysum (Everlasting flower)	... Alyssum
Linum Grandiflorum (Flot)	... Carnation
Nasturtium ...	... Candytuft
Pansy ...	... Cornflower
Petunea ...	... Coreopsis
Poppy ...	... Calandula
Phlot ...	... Chrysanthemum Sagetum
Mignonette ...	... Datura
Salvia ...	... Dianthus chivencis (Pinks)
Sweet Pea ...	... Gillardia
Small sunflower ...	...

Seed beds as suggested in the month of May, may be prepared, manured and kept ready for sowing. The seed beds must be forked just a day or two before sowing seeds as the seeds germinate better on freshly dug soil.

In order to obtain good results from sweet peas, have the trench dug to a depth of about $1\frac{1}{2}$ to 2 feet and after mixing in well-rotted cattledung manure in the excavated soil fill the trench and occasionally have the surface forked in order to keep back the weeds till sowing in October. Planting of croton cuttings, hedges and borders may be carried out in this month also.

Whenever weather and time permit, do not fail to hoe the flower beds.

For obtaining early flowers acclimatized astor and salvia splendens seeds may be sown in boxes or pots, by the middle of this month.

If not already done, stake the chrysanthemums and also do not fail to water them on open days. They should not be allowed to flag.

September.—First sowing of acclimatized seeds may be done in the first week of this month and second sowing of English seeds (imported) in the second and third weeks in instalments.

Seeds of tap rooted annuals such as candytuft, mignonette, nasturtium, alysseum may be sown in the last week of this month, direct in the ground where they are to grow.

If possible, first and second sowings of all the seeds which require transplantation may be done in boxes or pots instead of beds, particularly delicate seeds like poppy, petunea, nicotiana.

Balsams will be coming to an end this month and they should be removed without delay. The seeds obtained from these are not of much use since acclimatized seeds produce only single flowers.

In order to obtain big blooms on chrysanthemums disbudding and application of liquid manure should be started in this month.

Seedlings of salvias and acclimatized astors will be ready for planting. They may be transplanted in beds or potted in pots and transplanted in beds later on.

Operation of putting cuttings of different shrubs may be started in this month.

Budding of roses also can be started by the end of this month.

October.—Sowing of flower seeds, budding of roses and planting of cuttings may be continued during this month.

The rainy weather annuals which may be finishing up should be removed. If desired seeds may be collected from cosmos, cleomia, celosia, gamphrena, melampodieum, torenia, sunflower and amaranthus; but it is no good collecting zinnia seeds. As a rule acclimatized zinnia seeds produce mostly single flowers.

After preparing the beds any seedlings which may be ready from September sowing may be transplanted.

Sweet peas, candytuft, mignonette alyssum may be sown direct in the ground where they are to grow.

Pruning of roses and flowering shrubs may be carried out in this month.

Violets may be re-potted.

VEGETABLES

August.—Acclimatized cauliflower seeds may be sown in the first week where an early crop is required. As a rule cauliflowers produced from this seed are small, loose, and yellowish in colour, while those grown out of English (imported) seeds are solid, larger and whitish in colour and give good results.

The sowings of English cauliflower and cabbage seeds may be taken up from the middle of this month and may be continued till the end of September, at intervals of 10 or 12 days.

The first and second sowings may preferably be done in boxes and as soon

as the seedlings have produced five leaves they may be transplanted 2 or 3 inches apart on raised seed beds, prepared beforehand for the purpose.

The seed beds should be 6 to 9 inches higher than the ground level, and about 4½ feet broad and the length can be according to convenience.

During this season caterpillars are very troublesome to these seedlings. The following hints may be of some use.

Keep the surroundings free from weeds and grass. Hand picking of the caterpillars and spraying with arsenate of lead are more beneficial. If this is not available dusting with wood ashes is recommended.

In places where the duration of the cold season is short only early varieties of cauliflowers should be grown.

Early varieties.	*Late varieties.*
Early Eurfurt.	Magnum, Benum.
Early Snowboll.	Welchern.
Early Paris	Large Aseatic
The early giant.	

One ounce of seed contains about 1000 seeds of cauliflowers and about 800 seeds of cabbages.

It is desirable to sow a little more seed than is actually required for the area to be planted, specially in cases of cauliflower, cabbage and knolkhol. Not more than 50 per cent of the seed may be expected to produce good seedlings for planting.

Lettuce seeds also may be sown in this month for an early crop but these will not be nice and full.

Brinjal seeds can be sown for the cold season crop.

Country radish seed may be sown direct on ridges.

September.—The following vegetables may be sown in this month :—

Cabbage	Brinjal
Cauliflower	Beet
Knolkhol	Turnip
Lettuce	Carrot
Tomato	Radish (Local and imported)

Knolkhol seedlings will have to be raised in the same way as cauliflower and cabbage.

Lettuce, tomato and brinjal seeds will have to be sown in beds and seedlings, when ready, transplanted in their permanent places.

Seeds of beet, turnip, carrot and radish will have to be sown direct in the beds where they are to be grown.

French beans may be sown in the last week of this month as a trial.

October.—All the vegetables recommended for the previous months may be sown (except cauliflower) with advantage in this month for successive crops with better results.

In addition to the above-mentioned crops, peas, onions and spinach may also be sown in this month

Mint may be transplanted.

College and Hostel Notes

The College reopened after the summer holidays on the 16th of June, a week later than the date on which it used to open in the past years. The students and the staff are highly obliged to the Principal for saving them the trouble of assembling at a time of the year when it is really too hot to do any outdoor work at Nagpur.

The first year class was formed on the 1st of July with nearly fifty students on the roll and very few have subsequently left. The class thus is very strong in numbers this year. This clearly shows that the wider opportunities now thrown open for B. Ags. have attracted a large number of students, in spite of the fact that very few vacancies exist in the Agricultural Department of the Province.

An important change has been effected in the practical work of the II year students. Each student is now held responsible for the proper cultivation of a crop of cotton on a small area. The crop is to be tended during the spare hours available to the students. This accounts for the presence of some students on their plots on holidays and in the evenings, busy either with a khurpi or a bullock hoe instead of finding recreation on the Gymkhana ground or in the nearest picture house.

The crops on the College Farm are one of the best ever seen, partly due to the fact that the rainfall, although below normal so far in quantity, was seasonably distributed; and also due to the fact that no effort has been spared to weed and hoe the crops whenever the soil conditions permitted.

The health of the students was quite satisfactory. The students were inoculated against Cholera as soon as the Civil Station was reported to be infected. Strict measures were adopted in the hostel to prevent infection. One of the dining halls has been protected against flies by wire-netting screens. As this has proved effective it is expected that the other dining halls and kitchens will also be screened when funds become available.

Election of office-bearers for the various college activities took place in the middle of June. We congratulate the following who are elected as office-bearers for 1933-34:—

General Secretary	...	Mr. M. S. Nayar	*III year.*
Cricket Secretary	...	Mr. K. N. Thathode	*II year.*
Football Secretary	...	Mr. D. S. Dass	*II year.*
Hockey Secretary	...	Mr. R. L. Gupta	*III year.*
Tennis Secretary	...	Mr. M. S. Nayar	*III year.*
Indoor Games Secretary	...	Mr. N. G. Deshpande	*III year.*
The College Debating Society	...	Vice President. Mr. T. P. S. Choudhary.	
" " "		Joint Secretaries. { Mr. M. S. Anadeo Mr. Md. Luquman	

Cricket, Hockey and Football teams this year are undoubtedly superior to those who represented the College during the past few years. The secretaries have been showing keen interest and we hope they will achieve some success in the University sports this year. Special mention may be made of Messrs. K. N. Thathode and M. K. Deoskar (Cricket), Messrs. H. P. Shrivastav, K. R. P. Nayar and G. K. Bhalla (Football) and Messrs. R. L. Gupta and Md. Ishaque (Hockey).

Prof. Doraswamy Naidoo of Bangalore delivered a very interesting and instructive lecture on the importance of physical culture and how to live a hundred years. The exercises suggested by him though simple are sufficient to give plenty of exercise to every part of the human body. One should forget to always "smile" if one wants to live long.

We are thankful to Mr. E. L. Thoy for a gift of some interesting novels to the hostel Library.

The College Debating Society has been fairly active. An important alteration in the rules has been that the membership is now thrown open to all the students of the College instead of its being restricted to those who had taken an active part. Two debates which were well contested were held. The resolutions ran thus :—

(1) "In the opinion of this house the cinema is a great menace to society".

(2) "In the opinion of this house the College of Agriculture has failed to achieve its aims".

At the time of going to press the Ganapathi festival is in full swing. An account of the activities in connection with this festival will appear in the next issue. We are extremely glad to find that we possess among our freshers some musical talent. Mr. Verman plays very well on the *Dilruba* and Messrs. H. K. Dass, G. N. Deshmukh and Gondhalekar are very good in vocal music. We hope they will take seriously to it and further advance their knowledge and skill in this finest of the fine arts by seeking the aid of some *Vastads* in Nagpur. The above-mentioned young artists have in no small measure contributed towards the success of our social functions.

We take this opportunity of thanking our popular General Secretary Mr. M. S. Nayar for the keen interest he has been evincing in the various activities of the College.

Departmental News

Rao Sahib G. K. Kelkar, officiating Deputy Director of Agriculture, Eastern Circle, is confirmed in the Central Provinces Agricultural Service, Class I (new scale), with effect from the 7th February 1934, in an existing vacancy.

* * *

The services of Mr. D. N. Mahta, Economic Botanist for Cotton, Central Provinces, are temporarily placed at the disposal of the Indian Central Cotton Committee, Bombay, for a period of five years, with effect from the 20th April 1934. He will cease to perform all work on crops other than that on cotton with effect from that date.

* * *

Mr. Kalkaprasad Shrivastava, Extra Assistant Director of Agriculture and First Assistant to the Second Economic Botanist, Central Provinces, is appointed temporarily to do the work on crops other than cotton which Mr. D. N. Mahta was doing, with effect from the 20th April 1934, in addition to his own duties.

* * *

Mr. R. H. Hill, Deputy Director of Agriculture, Southern Circle, is temporarily appointed Deputy Director of Agriculture, Economics and Marketing, with effect from the date he assumes charge of his duties.

* * *

Rao Sahib G. K. Kelkar, Deputy Director of Agriculture, Eastern Circle, Raipur, is transferred to Nagpur as Deputy Director of Agriculture, Southern

Circle, *vice* Mr. R. H. Hill, appointed as Deputy Director of Agriculture, Economics and Marketing.

* * *

Mr. D. R. Moharikar, Extra Assistant Director of Agriculture, Raipur, is appointed to officiate in the Provincial Agricultural Service, Class I, and is posted to Raipur as Deputy Director of Agriculture, Eastern Circle, *vice* Rao Sahib G. K. Kelkar.

* * *

Mr. D. G. Sawargaonkar, Agricultural Assistant, in the upper division of the Subordinate Agricultural Service (Field Staff), is confirmed in the Provincial Agricultural Service, Class II, in the new scale of pay, with effect from the 8th May 1934.

* * *

Mr. G. D. Sawargaonkar will continue in the temporary post in connection with the cotton research work on the scale of pay as sanctioned in Central Provinces Secretariat Agriculture Department memorandum No. 606-XIV, dated the 29th May 1934.

* * *

Mr. Abdul Aziz, Agricultural Assistant in the upper division of the Subordinate Agricultural Service (Field Staff), is appointed to officiate in the Central Provinces Agricultural Service, Class II, as Extra Assistant Director of Agriculture, Raipur, *vice* Mr. D. R. Moharikar, appointed as officiating Deputy Director of Agriculture, Eastern Circle.

* * *

Leave on average pay for three months and twenty-two days combined with leave on half average pay for eight days is granted to Mr. Maniramsingh Barkar, Extra Assistant Director of Agriculture, Hoshangabad, with effect from the date on which he is permitted to avail himself of it.

* * *

Leave on average pay for one month is granted to Mr. G. V. Bakre, Agricultural Assistant, Balapur, with effect from the 15th July 1934 or any subsequent date from which he avails himself of the same.

* * *

Mr. M. N. Golwalkar, Agricultural Assistant, Akola, will look after the work in the Balapur Taluq during the absence of Mr. Bakre on leave, in addition to his own duties.

* * *

Leave on average pay for seventeen days with permission to affix Sunday the 15th July 1934, is granted to Mr. A. R. Padmanabha Aiyar, Extra Assistant Director of Agriculture, Nagpur, with effect from the 28th June 1934.

On expiry of the leave granted to him Mr. A. R. Padmanabha Aiyar is reposted as Extra Assistant Director of Agriculture in the Chemical section.

* * *

Leave on average pay for one month is granted to Mr. Laxmi Narayan Dubey, Extra Assistant Director of Agriculture, Chhindwara, with effect from the 29th July 1934.

* * *

Mr. V. R. Deshpande, Agricultural Assistant, Daryapur, is placed in charge of the Demonstration work in the Ellichpur Taluq as a temporary measure.

On relief by Mr. Deshpande Mr. N. R. Pande, Agricultural Assistant, Ellichpur, is transferred to Amraoti to work during the absence of Mr. N. K. Pendse, Agricultural Assistant, who is granted leave for 3 months.

On relief by Mr. Pande, leave on average pay for 3 months is granted to Mr. N. K. Pendse, Agricultural Assistant, Amraoti.

* * *

On expiry of the leave granted to him Mr. N. G. Sule is reposted as officiating Extra Assistant Director of Agriculture, Amraoti.

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Editorial Notes

INDIAN COTTONS IN LANCASHIRE.

The Ottawa Agreement gave an undertaking, without any commitments, to explore the possibilities of increasing the use of Indian cottons in Lancashire. The Board of Trade immediately gave effect to this undertaking by establishing an Indian Cotton Committee and appointing a Cotton Commissioner for India. The problem involved is essentially one of research. Medium staple Indian cottons can easily be used by mills accustomed to the use of American cottons but the quantity of such cottons exported from India is very small. India's exportable surplus consists of the short staple cottons.- the Oomras and Bengals- and the Lancashire Indian Cotton Committee is anxious that the British textile industry should use more and more of these cottons. The Committee enlisted the services of the Shirly Institute, Manchester, in solving the technical problems involved in the use of these cottons in the Lancashire mills. The results achieved by the institute are of considerable interest to the Indian public interested in cotton trade.

The spinning and weaving of coarse wefts is easy but little is known of the conditions governing the spinning aud sizing of warps from short staple Indian cottons. The spinning rollers used in Lancashsre mills are usually more than one inch in diameter and this is too large for short staple cottons processed in the normal manner. The replacement of these rollers would be very

expensive and the institute was anxious to find a way of overcoming this handicap without much expense and without detriment to the character of the yarn. The Institute has collected lots of data regarding the best twist factors for different hank numbers so as to give high strength of yarn. It has also made valuable recommendations on the draft to be employed at various stages in the card room and in spinning.

A special exhibition of Indian Cottons and methods of processing them was held at Shirley Institute early last year and was attended by rerepsentatives of most of the firms interested in textile trade. The cottons displayed were two improved Bengal types, a sample of commercial Oomras, Coconadas, and also three medium staple types of which *verum* was one. A demonstration was given of the best methods of spinning short and medium staple varieties, special attention being paid to the adaptation of large diameter rollers for the processing of these cottons in card and spinning rooms. The demonstration also included spinning under various high draft systems, weaving of warps sized to different extent and printing in various designs for European, Indian, and American markets. The Lancashire Cotton Committee are organising an exhibit at the British Industries Fair next February to demonstrate the suitability of various types of Indian cotton for an evergrowing range of finished products. It is learnt that this movement to increase the use of Indian cotton in Lancashire is being taken up widely with practical interest and a thorough realization of its importance.

EXPERIMENT IN CLIMATE CONTROL.

The decision of the Washington Government to plant a belt of trees over 1,000 miles long and 100 miles broad to bisect the mid-western drought area, at a cost of 45 million rupees, is undoubtedly a huge experiment in climate control.

The planting of such shelter belts is not entirely new to the world. In Hungary, Russia and Italy, shelter belts have been planted on a vast scale and the insecurity of farming in those

areas has been considerably reduced. On the steppes of Russia vast areas of forests were planted during the last century and tests made after the trees had grown to a good size showed that rainfall over the new forest area has been increased by 16 to 23 per cent. The trees send moisture into the air which then may condense and fall as rain.

Describing the American project Mr. F. A. Silcox, Chief of the Forest Department, says "Man cannot change all the forces of weather but he can modify his surroundings. He can ameliorate the effects of weather on a large scale. If the surface velocity of the wind over a wide area can be broken and decrased even slightly, soil will be held in place, the moisture of the soil will be conserved and havens of shelter will be created for man, beast and bird. This plan aims at permanent benefit."

The salient features of the American plan are as follows. The tree belt will extend from the Canadian border in the north to Texas in the south. Wind breaks about seven miles wide, running north and south, will be planted about one mile apart over the 100-mile belt. There will be approximately 100 parallel lines of trees. The area included will be about 20 million acres, of which approximately two million will be planted by trees. The land to be used will be acquired by Government through purchase, lease or agreement with farmers. The areas between the strips of trees will remain in private ownership. Approximately 90 per cent of the money to be spent will be paid to farmers largely for ploughing, fencing, planting and care of trees.

A PRIME MINISTER TURNS FARMER.

Mr. Lloyd George, one of the greatest politicians of modern times, is now a registered potato-grower. "I have ceased to be a politician. I have now become a cultivator of the soil" said the ex-Prime Minister of England. "I am happy" he said "happier than I have ever been in my life. Politics were fun. I enjoyed all that; but they were not somehow as satisfactory as this is." His farm at Churt is not the play ground of a retired statesman

but it is a definite contribution to the practice of agriculture. For when he took up the farm a few years ago, it was derelict on account of its low grade soil. Mr. Lloyd George has shown that even such soil can yield a rich harvest if properly farmed. He is now cultivating about 240 acres out of 500 and he is employing 31 men. In a demonstration at Surrey his potato plot was adjudged to be the best. His orchards are even better and his apples won him the first prize at the Crystal Palace.

Example is better than precept. This is what our leaders should do when they ask young men to go back to the land.

MARKETING INDIA'S AGRICULTURAL PRODUCE.

In a recent communique the Government of India has announced the establishment of a central marketing staff, as an adjunct to the Imperial Council of Agricultural Research, consisting of a marketing expert, seven senior marketing officers and ten assistant marketing officers. In addition, it is hoped that each provincial Government will appoint a marketing staff suitable to the needs of the province. The scheme, as at present envisaged, is for a period of five years and the Government of India is to find the funds required for the central as well as the provincial staff. The work of this marketing staff falls under three main divisions, viz. investigation work, development work, and work on grade standards. The investigation work will consist of a series of marketing surveys of the important agricultural produce, and animal husbandry products and will also tackle such questions as organisation of regulated markets, transport facilities, storage and standardisation. The development work will include the popularisation of recommended standards, grades, containers etc. For certain commodities like fruits and eggs it is expected that small packing stations will be started to demonstrate bulk sorting, grading and packing.

The Government of India hopes that in this effort to improve the marketing conditions of India they would have the hearty co-operation of the Indian States. It may be stated that a num-

ber of progressive Indian States have already appointed their own staff to take their share in this huge drive towards organising the marketing of India's agricultural products.

Original Articles

A BRIEF REVIEW OF SOME OF THE REASEARCH WORK CARRIED OUT BY THE CHEMICAL SECTION OF THE DEPARTMENT OF AGRICULTURE, C. P., NAGPUR.

BY D. V. BAL,
Agricultural Chemist C.P.

1. **Introduction.**—Owing to inadequate facilities in regard to accommodation, supply of gas and other factors, research work on chemical problems connected with agriculture could not be undertaken by the department till the year 1915 or 1916. When the existing Agricultural Research Institute building was completed and equipped to a moderate degree, facilities for conducting research work were made available and this review is intended to take stock of some aspects, only, of the agricultural chemical research carried out by the Agricultural Chemist during the last 18 years.

The subject of Agricultural Chemistry includes soils, plant and animal chemistry and certain physiological aspects of plant and animal growth. The logical sequence of order in reviewing the various problems would therefore be, to consider first the medium (soil) in which the plant normally grows, then the plant itself and finally the animal that feeds on the plant. This arrangement is therefore followed in the treatment of the subject matter of this article. The investigations referred to below deal with either the technical or the academical aspect of the subject, the latter being essential before any results of practical utility can be expected. As only a brief account of some of the investigations is intended to be given here, no attempt is made to present separately the academical and practical account of the problems considered. It may also be mentioned here that as it is not possible to review all the investigations that have so far been carried out, for the sake of convenience, the story has therefore been begun wherever it was deemed necessary, in order to make the whole account of as easy and popular a style as possible. A list of published research papers, bulletins and pamphlets relating

to the problems discussed has, however, been given for the use of those who may like to have the necessary information in greater detail.

2. **Soils and fertilisers.**—The essential preliminary to any investigations on soils is to obtain information regarding the physical and chemical composition of the various soils of a particular tract and in order to obtain the necessary information a number of soils from the cotton, rice, and wheat tracts of the Province have been analysed and we are now in a position to advise the agriculturists regarding suitable crops and fertilisers for particular soils and regarding their suitability or otherwise for purposes of irrigation with a view to growing garden crops.

3. The question of manuring the crops with appropriate organic manures or fertilisers in order to obtain high yields is very important in any agricultural practice. Generally, various kinds of oil cakes, and fertilisers like ammonium sulphate, sodium nitrate etc. are available in the market which can be employed for stimulating the crop growth. The availability of the manures, however, varies considerably according to the type of manure, and the soil to which it is applied, and a knowledge of only the chemical composition of the manures is not sufficient to assess their value.

Extensive experiments were therefore carried out to determine the availability of various manures and some very interesting results were obtained. It was for instance found out that the nitrogen of castor and *karanja* cakes becomes quickly available in the soil, but the nitrogen in the *mahua* cake is extremely inert and does not become available for the use of plants for several months.

4. From the results obtained we are now in a position to recommend certain oil cakes to the agriculturists of the Province with the confidence that if properly applied they will be to their financial advantage. An example of this is seen in the popularity of karanja cake amongst the sugar cane growers of Betul. We have also been able to save the agriculturist considerable sums of money by advising him not to purchase *mahua* or *gulli* cake, the nitrogen of which does not become available to plants for several months.

5. Indian soils are generally deficient in organic matter and the soils of our Province are no exception to this. Ordinarily, the cultivators use very little organic manure to enrich the soil and owing to the high temperature prevailing in most parts of the Province, such small quantities of organic matter as are normally present in the soil are continuously being lost at a rapid rate by the process of oxidation. An adequate amount of organic matter in the soil is absolutely essential in order that

the soil may be brought into the highest state of tilte and in order also to derive the maximum benefit of the various fertilising constituents which may either be present in the soil or which may be added in the form of fertilisers. One of the ordinary methods of maintaining soil organic matter is the application of sufficient quantities of farm yard manure to the fields. A large quantity of the cattle dung is however normally employed as fuel by the cultivators, and as long as no alternative source of fuel is available this practice is bound to continue.

Some recent investigations carried out in England, have shown that farm yard manure can be prepared artificially from various vegetable waste materials without the help of farm animals, and if the cultivators are careful enough to collect all the vegetable waste material from their fields and surroundings, and convert it into useful organic manure, the fertility of their fields will be greatly increased and the deficiency caused by the use of cattle dung as fuel will be made good to a very great extent. A number of experiments were therefore carried out which have clearly proved that artificial farm yard manure can be successfully prepared from various raw materials such as cotton stalks, leaves and weeds, and juar stubbles and stalks. The method has been simplified to suit local conditions, and can be worked out by the ordinary farm labourers in their spare time without involving undue, extra expenditure. As a matter of fact, the only extra expenditure involved is that of the cost of certain fertilisers required to be used as "*Starters*". A large amount of the surplus waste material from the various departmental farms is being treated by this method and converted into useful organic manure. A departmental pamphlet on the subject has recently been published in English, Hindi and Marathi for the use of cultivators of the Province. Figures 1 & 2 show some of the heaps of cotton stalks and juar stubbles which have been treated by the method on the college farm, Nagpur.

Organic matter added to the soil undergoes decomposition and this process is accompanied by evolution of *corbondioxide* which helps in the solubilisation of plant food. Experiments carried out to study this process of carbondioxide production from soils have yielded important results which show that immediately after any organic matter is added to the soil, there is a rapid evolution of carbondioxide, but after some time the process slows down, inspite of the presence of available energy material. This appears to be partly due to the accumulation of toxic substances produced by the soil micro-organisms.

A study of the usual Kjeldahl method, hitherto employed for the determination of nitrogen in soils, showed that low nitrogen values were

usually obtained. A modified method, which gives accurate results, was discovered some time ago which is now being adopted by research workers from other countries.

A study of the fluctuations in the moisture and nitrate contents of the black cotton soil was made with a view to finding out the fate of the nitrates applied as top dressing to crops, and finding out the most suitable time when nitrogenous fertilisers should be applied to crops like cotton. Results obtained clearly indicated that when the moisture content of the soil is less than 25 % or more than 40 %, nitrates are not formed in the soil and that a moisture content of about 30 % is optimum for the formation of nitrates. An application of nitrate to the cotton crop would therefore be extremely beneficial during a long continued rainy period, but if the rainfall is moderate, ammonium sulphate would be preferable as it will be easily converted into nitrates, due to appropriate soil moisture conditions. Relationship between moisture content and nitrate forming power of the soil is shown in figure 3.

3. **Chemistry of plants and plant products.**—Determinations of nitrogen and other constituents of sannhemp plant at different stages of growth were carried out with a view to determining the most profitable stage at which the plant can be used as a green manure. The precise conditions under which a green manuring crop should be turned into the soil so as to derive the maximum benefit from it for the succeeding crop have also been determined.

A number of strains of linseed, groundnut and castor evolved by the Botanical Section of the department were examined for their oil content in order to obtain definite information regarding their superiority or otherwise in comparison with the local varieties.

4. **Animal nutrition and Dairy Chemistry.**—In more recent years the extensive investigations carried out in New Zeland, Australia, and England have shown that the mineral content of the diet has a profound influence on the health, rate of growth, and productive capacity of various domestic animals. It has for instance been discovered that due to insufficient lime and phosphoric acid content of grasses from some pastures, the animals grazing on such pastures suffer from certain deficiency diseases like "Styfsiekte" (stiff sickness) "Fica" and Brittle bone. The question of depletion of pastures is therefore one of great economic importance.

Permanent experimental grass plots have therefore been recently laid out at Telankheri farm, in order to determine the mineral contents of the herbage at different periods during the growing season, and in order to study the effect of nitrogenous and phosphatic fertilisers on the quality

and the mineral content of the grasses. Results of these experiments obtained during the last 3 years have shown the following:—

(1) The yield of grass per acre from plots cut at monthly intervals is usually less than that obtained from the plots giving a single cut either at the flowering or at the dead ripe stage.

(2) The yield of grass whether cut at the flowering or at the dead ripe stage does not show any appreciable variation.

(3) Grass cut at monthly intervals is somewhat richer in phosphoric acid than that cut at the flowering stage and the latter is somewhat richer than that cut at the dead ripe stage.

Results of analyses of grasses indicate that the problem in so far as our Province is concerned, is primarily one of insufficient supply of grass rather than malnutrition due to lack of minerals in the existing supply.

These experiments further show that if the grass is cut early i. e. about the first fortnight of October, we can get as high yields as those obtained when the grass is cut at the usual dead ripe stage, and, in addition, the former type of grass will be richer in mineral content than the latter.

The data available on the nature of the butter and *ghee* produced in India being inadequate, it was found very difficult to fix suitable standards of purity in respect of those products, so as to exercise effective control on the practice of adulteration by the introduction of suitable Legislative measures. A number of analyses of pure butter and ghee were therefore carried out and the information obtained was useful in drafting the "Central Provinces Prevention of Adulteration bill", which was considered by the Central Provinces Legislative Council and an Act to that effect was passed in the year 1919. The then Agricultural Chemist was specially nominated as a member of the Legislative Council for the purpose of drafting the bill.

5. **Miscellaneous.**—About 2000 samples of various agricultural products such as soils, feeding stuffs, oil seeds, irrigation waters, organic manures and fertilisers received from the agriculturists of the Province and various departmental officers have been analysed. A large number of enquiries regarding suitability of well waters for purposes of irrigation, specific manurial problems and other technical matters are suitably dealt with every year. During recent years a number of enquiries regarding the manuring of orange trees had to be dealt with and a departmental pamphlet on this subject in English, Marathi and Hindi was therefore published for the use of orange growers.

A good deal of work concerning the utilisation of sewage was done

by this Section which provided useful data for the establishment of the Nagpur municipal sewage farm.

In many Eastern countries human waste products which are extremely valuable as an organic manure are efficiently utilised for increasing crop yields. In India this important source of organic matter and nitrogen has however been totally neglected for various reasons, although the cultivators realise the value of this material. With a view to encouraging the sanitary disposal of those waste products and their utilisation as manure, a departmental bulletin giving briefly the various methods of treatment has therefore been recently published.

On account of certain unavoidable circumstances it has not been possible to print the photographs and chart referred to in this article. They will be sent out as soon as they are ready. We tender our apologies to the author of the paper and to our readers for the delay :—EDITOR.

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Titles of the papers.	Names of authors.	Year of publication.	Where published.
1. The biological determination of the relative availability of different nitrogenous organic manures in black cotton soil.	F. J. Plymen and D. V. Bal	1919	Agricultural Journal of India, special science congress number.
2. Biological aspects of wheat cultivation on embanked soils.	F. J. Plymen and D. V. Bal	1920	Agricultural Journal of India, Volume XV.
3. Variations in some characteristics of the fat of buffalo and cow milk with changes in season and feeding and the mutual applicability of the analytical figures for butter fat and ghee.	F. J. Plymen and A. R. P. Aiyer	1921	Memoirs of the Department of Agriculture, India, Chemical series, Volume VI.
4. Studies on the decomposition of some common green manuring plants at different stages of growth in the black cotton soil of the C. P.	D. V. Bal	1922	Agricultural Journal of India, Volume XVII.
5. The relative nitrifiability of different nitrogenous organic manures in some typical soils of C. P. and Berar.	F. J. Plymen and D. V. Bal	1922	Agricultural Journal of India, Volume XVII.
6. Some factors affecting nitrogen changes in black cotton soil.	F. J. Plymen and D. V. Bal	1925	Agricultural Journal of India Volume XX.
7. The determination of nitrogen in heavy clay soils.	D. V. Bal	1925	Journal of Agricultural Science, Cambridge, Volume XV.

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Titles of the papers.	Names of authors.	Year of publication.	Where published.
8. Studies on carbondioxide production in soil and solution.	D. V. Bal	1926	Annal of Applied Biology, Cambridge, Volume XIII.
9. Influence of protozoa on the process of nitrogen fixation by Azotobacter.	D. W. Cutler and D. V. Bal	1926	Annals of Applied Biology, Cambridge, Volume XIII.
10. The effect of varying concentrations of ammonia on the nitrifying power of the soil.	D. V. Bal	1927	Agricultural Journal of India, Volume XXII.
11. A common error in the method of total nitrogen estimation in soils and its bearings on the results of nitrogen fixation experiments.	D. V. Bal	1927	Proceedings of the first international congress of soil science, Washington, U. S. A.
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13. Some aspects of the growth of rice in heavy black soils of the Central Provinces.	D. V. Bal and R. N. Misra	1932	Agricultural and Live-stock in India, Volume II.
14. Effect of varying moisture conditions on the growth of rice in typical light, medium, and heavy soils of the Central Provinces.	D. V. Bal and R. N. Misra	1933	Nagpur Agricultural College magazine, Volume VII-

15.	The availability of soluble phosphatic fertilisers in typical rice and cotton soils of the Central Provinces.	D. V. Bal and R. N. Misra	1234	Nagpur Agricultural College magazine, Volume VIII.

(2) *Bulletins and pamphlets.*

1.	The unsuitability of certain well waters for irrigation purposes.	F. J. Plymen		Departmental pamphlet.
2.	Oil cakes—Their uses as cattle food and manure.	F. J. Plymen		Departmental Bulletin.
3.	A decennial review of biochemical investigations on soils, carried out in the Central Provinces and Berar.	D. V. Bal		Departmental Bulletin.
4.	Manuring of oranges.	D. V. Bal		Departmental pamphlet.
5.	Preparation of artificial farmyard manure from surplus waste materials from the fields.	D. V. Bal		Departmental pamphlet.
6.	Utilisation of human excreta as manure.	D. V. Bal		Departmental bulletin.

PROSPECTS OF TOBACCO CULTIVATION IN THE CENTRAL PROVINCES & BERAR.

By B. S. Rao L. Ag. (Hon.)

The world's total production of tobacco amounts to 4,900 million pounds annually. Towards this total, India contributes 1,000 million pounds or nearly 20 % of world's production. India's production is second in quantity only to that of the United States of America which produces annually about 1,250 to 1,300 million pounds of tobacco leaf. Although the production of tobacco in India is large, still the amount of exportable surplus is very small, being only about 30 million lbs., the other 970 million pounds being consumed locally in some form or other. The tobacco that is exported consists chiefly of inferior types. The amount of high grade tobacco that is exported either raw or manufactured, is very small as very little high grade leaf is grown in India. The only province which grows high grade leaf is Madras. In addition to the large quantity of locally grown tobacco India imports large quantities of unmanufactured and manufactured tobacco. During 1931-32 the tobacco imports were as follows:—

Unmanufactured tobacco	28,000,00	lbs.
Cigarettes.	14,000,00	lbs.
Cigars.	210,00	lbs.
Pipe tobacco.	129,00	lbs.

Consumption of tobacco is still on the increase in India as all over the world. For instance in the United Kingdom in 1914 the *per capital* consumption was 2.4 lbs. while in 1927 it had risen to 3.4 lbs. It must be still higher today.

Another change noticeable in the consumption of tobacco all over the world is the growing popularity of cigarettes in preference to cigars and pipe tobacco. India has also followed the foot steps of other countries in this preference for cigarettes. This luxurious habit is of late being cultivated by women also in other countries. Although in India there is not much evidence of women smoking we cannot say that they will not fall victims to this so-called fashionable habit. So in India there is great need to increase the area under tobacco in general and of high class tobacco in particular, not only to meet her own wants, but also to increase her export. The preference which is at present given by the United Kingdom to the Empire-grown tobacco should serve as another stimulus to explore the possibilities of extending the area under

high class tobacco in every province. As each province is going to have a department to organise proper marketing of commodities it will be quite possible to pool all high-grade tobacco even if grown in small and scattered areas.

In the Central Provinces and Berar the area under tobacco at present is very small being only 19,000 acres or 0. 12 % of the total area under this crop in India. (The total area in India under tobacco, including Indian States is 136,00,00 acres). The distribution of this area in acres among the several districts of these provinces is as shown below :—

Buldana	2,435	Narsinghpur.	551
Amraoti	1,847	Seoni	458
Bilaspur	1,353	Chanda.	414
Yeotmal	1,211	Hoshangabad.	396
Drug	1,167	Wardha.	355
Balaghat.	927	Jubbulpore.	341
Akola.	883	Nagpur.	341
Chhindwara.	869	Mandla.	292
Saugor.	709	Damoh.	206
Raipur.	692	Bhandara.	94
Nimar	48		

It is found that the cultivation of tobacco in this province has considerably decreased since the extension of transportation facilities and, as a result, the influx of cheap tobacco from other provinces, thus rendering tobacco cultivation in the province unremunerative. It is on record that in 1870 there were over 50,000 acres under this crop in the C. P. and Berar.

The local production when compared with the local consumption is very small. Taking on an average 400 lbs. or 5 maunds of cured leaf from an acre, the total annual production of the province amounts to 80,000 maunds. This is supplemented by an import of 150,000 to 160,000 maunds of tobacco from the neighbouring provinces. The total local consumption may be roughly estimated at 230,000 to 240, 000 mds. per year, from the following data :—

Local production	80,000	maunds.
Imports	290,000	„
Total.	370,000	maunds.

Out of this 130,000 to 140,000 maunds are exported mostly as Biris to United Provinces, Bihar, Central India etc. thus leaving a balance of 230,000 to 240,000 maunds which is consumed in the Province.

In this connection it may not be out of place to draw the reader's attention to the importance of *biri* manufacture in this province. There are in all 866 factories out of which 185 factories belong to 'B' class and employ more than 50 workers each, and 681 belong to 'C' class employing less than 50 workers each. The total number of workers who depend on this industry for their living are:—

Men	18,257
Women.	10,073
Children.	13,910
Total.	42,240

The distribution of *biri* factories in this province is shown in the following table:—

District.	Total No. of factories.	Chief centres.
Bhandara	622	Gondia Tumsar Tirora Bhandara Sihora Hardoli
Jubbulpore	80	Jubbulpore Majholi Sihora Katangi
Nagpur	35	Kamptee Nagpur Ramtek
Raipur	28	Raipur Arang Dhamtari Bhatapara

The manufacture of *biris* offers employment to the agricultural class during their off-season. The industry is expanding in the Province. The profits of this industry would certainly be more if the raw material, instead of being imported, were raised locally.

Investigations on the lines following may prove useful in developing tobacco cultivation in Central Provinces and Berar.

Samples of the tobacco now being imported from other provinces should be collected and their characteristics should be studied.

A knowledge of the soil and climatic conditions of the localities in which the above types are grown should be gained.

The methods by which the imported tobaccos are cured in the localities in which they are grown should be properly studied.

Samples of seeds of various types of tobacco should be sent for and they should be sown on the different Government farms and their relative merits ascertained.

On the lighter soils, especially where irrigation facilities exist, cigarette types of tobacco like, Adcok, the most successful of the American varieties tried in India; type 142 evolved at Pusa by crossing Adcok with Type 28, the only Indian tobacco which is useful for cigarette manufacture, and certain other cigarette types that are being tried in Madras should be tried. The localities where they are likely to succeed are parts of Chhattisgarh, parts of Saugor district where the soil is light and is commanded by irrigation, and certain parts of Chanda.

Curing of high class cigarette types of tobacco is best done by the flue curing process which implies the presence of specially constructed barns. It is encouraging to note that from the grants allotted by the Imperial Council of Agricultural Research two barns are going to be constructed, probably in the Eastern Circle. If the department succeeds in introducing high yielding, high class cigarette types of tobacco and also in curing it, it may not be long before we find a number of privately owned barns springing up in certain parts of the province. In the Guntur district of the Madras Presidency, there are nearly 1,400 barns operating annually.

Extracts

IMPROVED VARIETIES OF CROPS PRODUCED AT PUSA *

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The production of varieties of crops superior either in quality or yielding power to those already in culture in India has been the principal work of the Botanical Section at Pusa. A short description of some of the well-established Pusa types was published in 1925 but progress in the last ten years has resulted in the evolution of many new forms and seed of these is now available for the agriculturist. The present brief article has been written with the object of attracting the attention of growers and of provincial departments of agriculture to those types which are either of established repute or are worthy of trial.

Wheat (*Triticum vulgare Host*).—Wheat is rabi crop, sown in October or November and reaped in March or April.

Pusa 4.—was evolved by selection from indigenous forms. It is an early wheat of good standing power and fairly rust resistant. It is well suited to the soil and climate conditions of Bihar, and has also done well in the Budelkhand districts of the United Provinces and in the North-West Frontier Province. In Australia it was awarded the first prize at the Royal Agricultural Show at Sydney in 1916, 1918 and 1920, and is one of the wheats regularly distributed by the Queensland Agricultural Department. It also gained a special prize at the Food Products Exhibition at Calcutta in January 1920. Pusa 4 will grow and yield well under minimum conditions of soil moisture; being an early maturing variety of low tillering capacity it generally yields less heavily than other Pusa wheats, but under favourable conditions very heavy yields have been recorded for this wheat. In the Botanical area at Pusa yields of grain of 36 maunds (1 md.—82 lb.) per acre were obtained in 1925—an exceptionally favourable season of optimum moisture conditions, and in 1920-21 a yield of 40 maunds per acre was obtained under estate conditions at Bhagalpur. In the United Provinces in 1921 this wheat yielded 26 maunds per acre. It should be sown at 40 seers to the acre.

Pusa 4.—Young shoot erect, height medium, not much tillering, leaves bluish green. Ear beardless, lax. Glume pubescent, white. Grain blunt at the apex, hard, medium. Total percentage of nitrogen 1.92, protein 10.94.

* *Agriculture and Live Stock in India* Vol. IV Part IV. Septr. 1934 P. 465.

Pusa 111—This is an early-maturing wheat and is a selection from a natural cross or possibly a mutation in Pusa 4. In morphological character it differs from the latter wheat only in possessing smooth glumes. This is a desirable character as the felted glumes of Pusa 4 hold moisture in damp weather and tend to increase the incidence of rust in the earhead. It is as good a yielder as Pusa 4 and according to the recent milling and baking tests it is a "hard" wheat equivalent in value to a good Manitoba wheat. If it can be successfully grown in India, it should be of commercial importance as a strong wheat. It is most attractive in appearance, although quite unlike manitoba, its bright amber colour being in sharp contrast to the typical Manitoba. It should be sown at 40 seers to the acre.

Pusa 111.—Young shoot erect, height medium, tillering moderate, leaves bluish green. Ear beardless, lax. Glume glabrous, white. Grain blunt at the apex, hard, medium. Total percentage of nitrogen 2.23, protein 12.72.

Both Pusa 4 and Pusa 111 may be recommended to cultivators where early-ripening varieties of low water requirement and good grain qualities are required. In both the varieties the grain has a thin skin and consequently yields a high percentage of flour, as a result of this thin skin these wheats are liable to lose their power of germination unless properly stored during the rainy season.

Pusa 80-5.—is a hybrid between Pusa 4 and Pusa 6. It is a beardless wheat having grain quality similar to that of Pusa 4 and a very strong straw. It is earlier than Pusa 12 but slightly later than Pusa 4. It has given an outturn of 20 maunds of grain per acre at Pusa, 22 maunds at Cawnpore, 25 maunds at Gurdaspur, and 30 maunds at Sepaya. It should be sown at 40 seers per acre.

Pusa 80-5.—Young shoot erect, height medium, tillering fairly well, leaves bluish green. Ear beardless, lax below and dense above. Glume glabrous, white. Grain hard, medium. Total percentage of nitrogen 2.22, protein 12.64.

Pusa 12.—This is well suited to the soil and climatic conditions of the United Provinces and Punjab, and has also been successful in Bihar. It is a heavy yielding wheat, and in the United Provinces in 1921 it yielded 26 maunds per acre over an area of 50 acres. In Bihar it appears to be inferior in rust resistance to Pusa 4 but it is better in this respect than other local wheats. It is later in ripening and the grain is lighter in weight than that of Pusa 4 or, Pusa 111. It was evolved by selection from indigenous forms. It should be sown at 30 seers to the acre.

Pusa 12.—Young shoot prostrate, height fairly tall, tillers heavily, leaves yellowish green. Ear beardless, lax, long. Glume glabrous, red. Grain soft, long, white. Total percentage of nitrogen 1.81, protein 10.32.

Pusa 101.—This is an exceptionally early-maturing good, productive, bearded wheat. It was produced by crossing Muzaffarnagar—a high-yielding bearded

wheat with Pusa 22. Pusa 101 has been found to suit certain parts of the Central Provinces, where it is regularly distributed. This wheat is adapted to conditions in the southern wheat-growing areas of India where an early hot weather renders a type with a short life cycle essential. It should be sown at 30 seers per acre.

Pusa 101.—Young shoot erect, height, tillers profusely leaves yellowish green. Ear bearded, lax, awns white. Glume glabrous, white, Grain hard medium.

Pusa 52.—This wheat was produced by hibridization between Punjab 9 and pusa 6. The high yield and bearded nature of one parent (Punjab 9) is combined with the good grain quality and rust resistance of the other parent. The straw is strong and in Bihar this wheat stands well and is fairly resistant to trust. It is a heavy-yielding, bearded wheat and the Botanical area it has given 27 maunds per acre, over an area of 4 acres. It is later in maturity than Pusa 101. Pusa 52 is now the principal wheat of North Bihar. It should be sown at 30 seers to the acre.

Pusa 52.—Young shoot prostrate, height fairly tall, tillers heavily, leaves deep green. Ear bearded lax below and dense above, awns white. Glume glabrous, white. Grain medium, hard. Total percentage of nitrogen 1.95, protein 11.12.

Pusa 114.—This is a late maturing wheat which was selected from a natural cross in Australian 'Federation'. It has a tendency to shatter some of its grain at muturity. It is a wheat of good standing power and tillers profusely. It possesses rather too long a growing period to give good results in Bihar, but it has been very successful in Sind. It should be sown at 30 seers per acre.

Pusa 114.—Young shoot prostrate, height fairly tall, tillers heavily, leaves dark green. Ear bearded, slightly dense, awns brown, ripening black. Glume pubescent, brown. Grain small, roundish, hard. Total percentage of nitrogen 2.07, protein 11.80.

The bearded wheats Pusa 101,52 and 114 are gaining popularity in places where the crop is liable to be damaged by wild animals or birds.

The milling and baking qualities of the Pusa wheats (Shaw and Khan, 1931) have been exhaustively studied in recent years and the results prove conclusively that 'strong' wheats can be produced in India. Pusa 111 stands first in this respect but all the Pusa wheats show a relatively high protein content ranging from 10.3 per cent, to 13.1 per cent. The straight flours from Manitoba wheats generally contain 10 to 12 per cent. protein, Australian 8.15 per cent Indian 7.9 per cent.

Table showing the protein and nitrogen content of Pusa Wheats.

Wheat.	Sample No.	Moisture content.	Total nitrogen (recalculated on a 15 perecnt moisture basis.)	Total protein.
Pusa 4	1	10.43	1.92	10.94
Pusa 12	2	10.95	1.81	10.32
Pusa 51	3	10.65	1.95	11.12
Pusa 80-5	4	10.45	2.22	12.64
Pusa 111	5	10.20	2.23	12.72
Pusa 114	6	10.71	2.30	13.12

Gram (*Cicer arietinum L*).—Fifty-nine new types (Shaw an Khan, 1931) of gram were isolated in 1930 ; with the original 25 types (Howard and Khan, 1915) a total of 14 varieties is now available. Gram is a *rabi* crop sown in Bihar about 25th October and on irrigated lands in the Punjab about one month earlier. The seed rate is about 15 seers to the acre.

The original standard types of high yielding power are the yellow seeded Types 17 and 25, to these the new Type 58 which has been tested against Type 17, must now be added. Type 58 has up to the present proved the highest yielder in this group of grams. Among white seeded types commonly called "Kabuli" grams, Types 2, 6 and 28 are the best yields.

The important characters of the above mentioned varieties are given below:

Type 17.—Plants late and of somewhat spreading habit; flowers pink, standard light pink, wings violet above and pink below with a slight bluish nieag ; seed yellowish brown turning to reddish brown when mature, irregular in shape, smooth, small, weight of 1,000 seeds 125 grms. Widely grown in North Bihar, Average yield 1,550 lbs. per acre.

Type 25.—Plants erect, medium in maturity, flowers pink standard and wings reddish seeds like those of Type 17 but a little smaller, weight of 1,000 seeds 113 grms. Average yield 1,500 lbs. per acre.

Type 58.—Like Type 53, but it is medium in maturity and having smaller flowers, weight of 1,000 seeds 133 grms. Average yield 2,400 lbs. per acre.

Type 2.—Plants erect and early ; leaflets, flowers and pods large, flower white ; seed white with a reddish yellow tinge, round, puckered, large, weight of 1,000 seeds 408 grms. Average yield 750 lbs. per acre.

Type 6.—Plants early and somewhat spreading; seed small, white with a yellow tinge, irregular in shape and smooth, weight of 1,000 seeds 125 grms. Average yield 1,300 lbs. per acre.

Type 28.—Like Type 2 but the size of leaflets, flowers pods and seeds is medium; weight of 1,000 seeds 193 grms. Average yield 1 300 lbs. per acre.

Chillies (*Capsicum annum L. and Capsicum frutescens L*).—Fifty-two different types (Shaw and Khan, 1928) have already been isolated. Of these four promising types with long, thin, red, pungent fruits have been tried on a field scale and Types 34, 41 and 51 have proved to be the best yielders under Bihar conditions. In 1930-31 Types 34 and 41 gave green weights of 6,591 lbs. and 10,173 lbs. of ripe chillies respectively per acre. The seed of these types is available for distribution in limited quantities.

The description of these types is as follows:—

Type 34.—Plants tall, very early, very prolific, annual; leaf light green; flower one in the axil; corolla white; fruit medium in length. elongated circular in transverse section, pendent, unripe green with moderate purple colour, becoming red when mature.

Type 41.—Plants tall, early, very prolific, annual; leaf dark green; flower one in axil; corolla white; fruit long, elongated, circular in transverse section, not wrinkled, pendent, unripe green with much purple colour, becoming red when mature.

Type 51.—Plants tall, early, very prolific, annual; leaf dark green; flower one in the axil; corolla white, fruit long, elongated circular in transverse section, wrinkled, pendent, unripe light green with much purple colour, becoming red when mature.

The season and the time of sowing of seed beds and transplanting of seedlings varies according to localities. In Bihar, seeds are sown in July, and transplanting takes place by middle of August. The spacing usually given is 1½ ft. x 1½ ft but this varies in other localities. One acre generally requires 1 lb. seed.

Tobacco (*Nicotiana tabacum L*).—Tobacco is a *rabi* crop sown late in August and reaped in February or March. It is cultivated more or less all over India but 75 per cent. of the total production is from Madras, Bombay, Bengal and Burma. The type of leaf required for consumption in the country by indigenous methods is a thick heavy leaf and to produce such a crop it should be grown on heavily manured lands. Types 28 (Howard and Howard, 1910) and 63 (Shaw and Kashi Ram, 1932) are very suitable strains for this purpose, he former is a late maturing type and the latter is a very heavy yielder. Large quantities of seed of Type 28 have been distributed in Bihar. These types have yielded 12 to 15 maunds of dry cured leaf per acre at Pusa.

The development of the tobacco trade in India in recent years has been in the direction of producing a tobacco suitable for cigarette manufacture. For this purpose the leaf should be thin, elastic and cured to a bright yellow colour. The production of tobacco of this quality requires special methods of culture, and curing which have already been described in detail (Shaw cnd Kashi Ram 1928). None of the indigeneous tobaccos however are capable of yielding a cigarette leaf of the required texture, flavour and colour and for this purpose resort must be had to exotic varieties or to hybrids between exotic and Indian types. Among exotics, Adcock and Harrison's Special have given good results and two hybrids between Adcock and Type 28, designated as H. 177 and H. 142 (Kashi Ram, 1931), have also proved very suitable. Yields of about 600-800 pounds of dry cured leaf per acre have been obtained at Pusa. Half a *ohatak* seed is enough to raise seedlings for acre.

The characters of the types mentioned above are as follows:—

Type 28.—Plants tall, lower internodes short, upper long. Leaves sessile, elliptical; surface rough with slight folds or ridges; lamina not fully expanded but folded on the midrib, dark green and thick.

Type 63.—Plants tall, lower internodes very short, upper long. Leaves sessile, elliptical, slightly rough, dark green and thick.

Hybrid 142.—Plants tall, internodes medium. Leaves distributed at an equal distance on the stem, sessile, ovate, smooth, light green and think.

Hybrid 177.—Plants earlier than 142, tall, internodes long. Leaves distributed far apart on the stem, sessile elliptical, slightly rough, light green.

Adcock.—Plants medium in height, internodes medium. Leaves sessile, elliptical, smooth, dark green and thin.

Tobacco (*Nicotiana rustica L.*)—For indigenous consumption in a Hook, etc., the yellow flowered tobacco is widely cultivated in Eastern Bengal, Assam, Bihar, United Provinces and the Punjab. This species is hardier and requires a shorter time to mature. It is grown all over the provinces mentioned above as a cold weather crop. It can be grown both on alluvial and clayey soils, provided the latter are well drained and free from water-logging. It requires heavy manuring and on soils such as those of Bengal, Bihar and Assam which retain enough moisture for plant growth it is usually grown without irrigation, but in the United Provinces and the Punjab it needs copious irrigation. As the leaf possesses a high percentage of nicotine it is not used for cigar or cigarette manufacture. Twenty types of N. rustica L. (Howard and Howard 1910) have been isolated on which Type 18 has proved the heaviest yielder. The average yield of the dry cured leaf with the stem is about 15 to 20 maunds per acre. Half a chatak seed is enough to raise seedlings for one acre.

Type 18—Plants vigorous, late, height medium; leaves orbicular, very large, surface much puckered, colour dark bluish green.

THE CURING OF GINGER.*

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Methods of curing ginger.—There are two well-known methods of curing ginger: (1) Sulphur curing (2) Ordinary curing. Sulphur curing has a number of advantages over ordinary curing. The product obtained is much lighter in colour, more plump, and of better keeping quality and fracture than ordinary cured ginger. But with the introduction of legislation in most of the purchasing countries preventing the sale of ginger containing sulphur dioxide, this method is now of very limited application. Last year a thorough investigation of the process was made by the Chemical Division, and a full account given in The Tropical Agriculturist of May, 1933. Samples of sulphured ginger sent to the Imperial Institute for valuation were reported on favourably with regard to appearance, aroma, flavour and pungency, but owing to the prohibition of the sale of sulphured ginger in Great Britain, none of the samples were saleable. It was recommended however, that attempts be made to prepare dried ginger without the use of sulphur, as the variety of ginger grown in Ceylon appeared suitable for the purpose.

Varieties of local ginger.—Large scale trials were accordingly made this season with the curing of no less than four tons of green ginger by the ordinary process. For curing purposes two varieties of ginger are available in Ceylon—'local' ginger which appears to be a degenerated type of Calicut ginger and a variety grown in the neighbourhood of Nugegoda and hence spoken of as "Nugegoda ginger," which is a mixture of Cochin variety and the local type. There is in addition a small quantity of China ginger which is only suitable for preserves or for use as green ginger. The local variety occurs in hands of comparatively small thickness, unlike typical Calicut ginger which has large, plump hands. It has generally numerous fingers which necessitate breaking the ginger into small pieces before curing and make peeling a difficult and expensive item. It is very fibrous, like Calicut ginger and when peeled is of a pale-cream colour. The typical Cochin ginger has fewer fingers, is much less fibrous and is generally plumper, and when peeled is of a bright canary yellow colour. The Cochin variety from Nugegoda ginger if cured in the proper way gives a plump light buff-coloured product, of good aroma, flavour and fracture. The local ginger,

* The Tropical Agriculturist, Volume LXXXIII. No. 4 Oct. 1934 Page 212.

on the other hand gives a thin, much darker coloured and more fibrous product, but otherwise is no different to Cochin ginger. Every attempt should therefore be made, if ginger is to be cured for the foreign market, to grow the former variety, small-scale selections from which are being multiplied by the Agricultural Department.

The ordinary curing process.—For ordinary curing it is absolutely essential to have a continuous spell of at least ten days of good sunshine and a plentiful supply of clean water. Normally 7 to 8 days of good weather will be sufficient. Should rain fall on the material in the interval, especially during the first four days, the product becomes quite dark in colour and mildewed and gives a musty odour and flavour. No amount of subsequent washing and drying will improve its appearance and flavour. Ginger curing will therefore be possible only during a very limited period. Generally, the crop planted in March—April is ready for harvesting the following January, and curing should be begun as soon as possible after that when a spell of dry weather is assured. In most ginger growing districts February-March will be found to be a suitable period for the purpose. If a light coloured product is desired, curing should be started as soon as the crop is harvested. It is advisable to harvest only the quantity required for a day's peeling. If for any reason it becomes necessary to harvest the whole crop, the rhizomes should be placed in a well-aired room in small heaps, dry soil being spread over successive layers of ginger. The rhizomes to be cured are put into a tank of water and thoroughly cleansed of adhering earth. The water is drained off and the ginger allowed to soak overnight in a fresh supply of clean water. This operation is especially necessary for clean peeled ginger. Next morning the ginger is peeled. A special knife has been devised for the purpose: It consists of a thin iron blade about half inch broad at the base and tapering to about a tenth of an inch at the tip. In length it is about 4 inches. One face of the blade is flat, while the other has a bevelled edge. The knife as designed scraps but does not cut the peel, the essential oil which appears to be concentrated just below the skin being thus retained. It has also the advantage of both clockwise and anti-clockwise working.

Peeling may be either rough or clean. Rough peeling consists in the removal of the peel from the broad faces of the rhizome and sometimes from the side face as well. No peeling is done between the fingers. For the local market, rough peeling is all that is necessary. For the English market however, clean peeling is essential. This is a much more difficult and slow task and more expensive. Care should be taken to minimise as much as possible the breaking of the hands when peeling between the fingers. Unless the prices obtained for clean peeled ginger exceed Rs. 35.00 per cwt. it is very doubtful if

it will pay to produce such ginger. A woman can ordinarily roughly peel about 28 lb. of raw ginger, a day. Individuals may peel up to 40 lb. at 30 cts. a day, rough peeling will cost Rs. 7. 20 for 6 cwt. of green ginger, the equivalent of 1 cwt. of dry ginger. Good clean peeling, is much more expensive, and it is our experience that not more than 10 lb. per day can be expected from an average peeler. Up to 14 lb. can however be cleaned by expert peelers. The cost of clean peeling a cwt. of dry ginger would work out to about Rs. 20.00.

Immediately the rhizomes are peeled they are put into water and the gummy exudation removed by washing. This is very essential if a light coloured product is to be obtained. The ginger is then transferred to a tank where it is washed in succesive changes of clean water and then allowed to soak in water overnight. Washing is one of the most important operations in ginger curing.

Next morning the ginger is again washed in clean water and trasferred to bamboo or cement brabecues to sun dry as soon as the mist has lifted. Wherever possible, drying on a slab of rock is advised. An important task in ginger drying is turning. Especially on the first day, every hand must be turned over. A good practice would be to start turning the hands at mid-day. On subsequent days they should be turned twice or thrice, but care should be taken that in handling the ginger is not broken. Drying should proceed for 5 to 6 days accompanied by regular turning, after which time, if the weather has been favourable the rhizomes should be quite dry to the feel. On the sixth or seventh day, the ginger is again well washed in clean water. The second washing improves the colour appreciably and is only required when preparing clean peeled ginger for the foreign market. Drying is continued for 3 or 4 days after the second washing, when the ginger should be ready for bagging. On no condition should bagging be done if the ginger is not thoroughly dry. Good dried ginger will not appear damp to the touch and would give a sort of ring when lifted and dropped. Even after bagging, it is advisable to expose the ginger periodically to the sun. Unless ginger is thoroughly dried it is very liable to mould attack in storage.

Modifications of the process.—It will be observed that crude peeled dry ginger from India sold in the local markets, has often the appearance of being earth soiled. On enquiries made it is learnt that such ginger is prepared with a definite object viz., prevention from mould attack. It is reported to be prepared by soaking peeled ginger, for an hour or so in a mixture of red earth and water of the consistency of whitewash and then drying. The earth used is understood to be white ant nest earth or a special red clay. The object of this treatment is apparently to give the rhizoms a coating of an adhesive substance which will act as a preventive against mould attack. Clays have the property of adhesive-

ness and termite nest earth has in addition a quantity of gummy material secreted these insects. Experiments carried out locally have indicated that termite nest earth is very suitable for the purpose. It has been found that the best stage to soak the ginger in the clay mud is soon after peeling. Such ginger takes a longer time in drying, but it gives a dry, hard final product which does not become damp to the touch even after a spell of rainy weather. This method of curing ginger is, in a way, cheaper than that described, and if it has the advantage claimed for it of keeping better, it is one to be advised. But it will not be suitable if the ginger is required for grinding purposes. Ordinary dried ginger has also been soaked in mud wash and re-dried, but the product is not so satisfactory, the clay coating not being retained to the same extent. From the practical standpoint there would be little advantage in this process, but if by so doing a stock of dry ginger can be prevented from being attacked by mildew, there would be some value in its adoption.

Another modification of the processes of ginger curing is in regard to peeling. In certain parts of India instead of peeling by hand the ginger is treaded under foot in tanks after it has been well soaked in water. This entirely eliminates peeling costs; but only the outermost layer of the peel is removed and hence the drying is very slow. It takes from 12 to 15 days to dry ginger locally under this conditions. Further, the rhizomes get broken into small pieces and their marketable value is thus lowered. The practice is not to be recommended for local usage, especially where weather conditions are variable.

Gleanings.

Uncle Sam Enters Fertilizer Business.—During the Word War, the United States Government erected two plants at Muscle Shoals, Tennessee, for the manufacture of nitrates to be used in explosives. Since 1918, these plants have lain idle in spite of many proposals for their peace time utilization. Now, however, as a part of the War on Depression, Uncle Sam, through the Tennesee Valley authority, proposes to utilize the Muscle Shoals chmical factories but instead of producing nitrates for explosives, it is planned to manufacture phosphates for fertilizers. Dr. Harry A. Curties, chief chemical engineer of the TVA is the man who made the decision to scrap the whole idea of using the Muscle Shoals nitrate plants for their original purpose. "The fact is," he says, "that since these Government factories were built, new processes for the fixation of atmospheric nitrogen have been developed to

such a point that the plants built at the time of the World War are now obsolete." America can now manufacture cheap nitrates adequate for any conceivable demand. One of the other essential fertlizer ingredients, however, phosphate, has lagged behind because the conventional method of treating phosphate rock with sulfuric acid is cheap and easy. Dr. Curtis, however, hopes to improve on this process by manufacturing the cheapest phosphoric acid possible as the starting point for the manufacture of the most concentrated fertilizer. We are converting two of the carbide furnaces in the nitrate plant at Muscle Shoals into phosphate furnaces" says Dr. Curtis in an interview in Chemical industries. "In the meantime, we are building a plant to produce triple super phosphate fertilizer which will run as high as 54 percent P_2 O_5. With important deposits of phosphate rock right in the middle of Tennessee I think we can make concentrated super phosphate cheap enough for fertilizer use." (*Scientific American*).

The value of honey.—Mr. H. Willoughby Lance, Agriculturist, Department of Agriculture, Western Australia, summarises the value of honey as a food under six headings: (1) It is the only natural sweetening substance, everything else like cane sugar and beet sugar having been refined from other material during which process all else that is not plain sugar is removed. (2) It has already been changed or digested by the bees and is almost immediately assimilated into the body. (3) It is an energy producing food. (4) It contains mineral and other substances so necessary for the maintenance of health. (5) Its hygroscopic properties make it almost impossible for disease germs to live in it. (6) It is pleasant and attractive to the taste. In addition to these it is a well known cure for colds on the chest, influenza, sore throat etc., if taken with hot milk or lemon. As a cure for constipation a dessert spoonful in a glass of hot water night and morning always nearly cures this trouble. It is a wonderful remedy for boils, carbuncles, septic poisoning etc. For toothache, Emmet Baxter (Philadelphia) says," I have sold numbers of people honey for this specific purpose and every one of them without exception has told me that it worked like a charm". "Just take a big swallow in the mouth and hold around the affected tooth for a while. It usually does the trick in a few minutes." Honey is an excellent cure for bee stings and inflamed and sore eyes. Equal parts of honey and cream mixed together is an excellent cosmetic, softening and beautifying the skin. (*Queensland Agricultural Journal.*)

Japanese imports of Indian raw cotton reach peak.—The Cotton Spinners' Association of Japan recently announced that the volume of Indian

raw cotton shipped to the accounts of the associate companies from January 1 to the middle of July was 1,520,299 bales, the Tokyo *Asahi* reports. The volume of Indian cotton Japan was obligated to buy, in order to cover a quota of 400,000,000 square yards of cotton textiles eligible for importation to India, was 1,500,000 bales, a little more than which have been received with about one-half of the time requirements. During the remainder of the season, Japan will receive about 50,000 bales at a concervative estimate. Therefore, the total volume of Indian raw cotton imported to Japan during the current season will not be less than 1,800,000 bales. Heavy shipments of raw cotton from India to Japan is attributed to the high market prices of American raw cotton, due to measures adopted in the United States to curtail cotton acreage, Government aid in storage and other measures conductive to price boosting. On the other hand, Japanese spinners began the current season with diminished stocks, having refrained from making purchases toward the close of 1933 on account of political reasons. As Japan has already bought all the raw cotton she is expected to get from India this season, the privilege of shipping cotton textiles to that country up to the fixed quota of 400,000,000 square yards during the year ending March 31, 1935, is now definitely confirmed. (*Indian Textile Journal*).

Importance of cooling cream.—The first step towards controlling the action of bacteria in milk and cream is to prevent such organisms as have gained access to these product from multiplying to suffiicent numbers to cause trouble. The only way to do this is to cool the milk or cream as much and as soon as possible. In the absence of water being laid on to the separating room, any of the small water-bag coolers, to cool the cream straight from the separator or the milk immediately it is drawn, are very efficacious, as every degree of temperature we bring the product below 80 degrees Fahr. will have a retarding effect on the bacterial development, and in many cases (in relation to weed taints, etc.) the aeration will improve the flavour. If a cooler is not available a lot can be done by standing the milk or cream cans in cold water or putting wet bags round them, but it must always be remembered that fresh water is advisable each day, and the bags should be changed each day and allowed to dry. In the case of cream it should be stirred with a tinned metal stirrer two or three times each day, and not be mixed until each lot of cream is cool. Finally, it should be delivered to the factory daily if possible. With reference to the delivery of cream, many producers, after taking as much care as possible on the farm, allow the product to become heated in transit to the factory, either by not having a well-shaded stand

or, when they do the carting themselves, by not taking the trouble to keep the cans covered (by, say, clean wet bags.). This neglect may very often be fatal to quality. (*Queensland Agricultural Journal.*)

Effect of artifical light on Hen's eggs.—It has long been known that artificial light has an influence on poultry, and many of the hen-houses of of Lancashire now have electricity laid on. It is understood that the deluded fowls, imagining themselves surrounded by perpetual daylight, are induced to lay more freely during months when they would ordinarily restrict production (say the "*Manchester Guardian*"). Now it is reported that "giant chickens, reared in artificial sunlight, are to be bread in Moscow so that Russian workers will be able to afford chicken dinners." So it seems to be assumed that more light will lead to large chickens, even as it leads to more eggs. But it does not, to judge by the ordinary examples now encountered in English commerce. On the contrary, the hens's egg seems to be getting smaller and smaller, a process which some of us have attributed to this artificial-light theory whereby the hen lays more often but lays less generously in point of size. If that is true in the case of eggs, there may be a disappointment in store for the Russian promoters of the plan for outsize chickens. So far from producing a chicken the size of a turkey, the artificial light treatment may yield a cloud or cover of silly little things the size of sparrows, and that "Russian workers", instead of being able to cut and come again at one prodigious fowl, may have to buy them by the dozen in order to make a modest pie for a single meal. (*The Hindu*).

A new Draining machine.—A new draining machine which makes and lays in one operation continuous concrete pipes in the subsoil without any excavation is described by Dr. H. Janert of the Liepzig University in Tropical Agriculture. Although porous concrete pipes have already been successfully used for underdrainage and subsoil irrigation the full advantages have not hitherto been obtained on account of the high expenses of construction. This new machine cheapens the construction of such pipes by about 90 per cent and thus opens up new prospects for subsoil irrigation and drainage. The machine consists of a mole plough carrying a special equipment which forms an endless porous concrete pipe in the tunnel left by the mole. The pipe is made while the mole is actually passing through the soil. The procedure has been tried long ago but with little success. The wet concrete mixture previously used either choked up the supplying tube or did not hold the pipe profile according to the moisture content of the material. The essential innovation of the new machine lies in the forming of the pipe which is

done with dry material and the dry pipe is then wetted from the inside. By this method a faultless uniform pipe is obtained without smearing of its surfaces so that the moles of the concrete pipe remain permeable. The permeability can be largely regulated by altering the proportions of the cement sand mixture.

Preparation of Oranges for Shipment.—A recent paper in Industrial and Engineering Chemistry, July, 1934, Vol. 26, No. 7, pp. 762-765, by J. R. Winston, of the Bureau of plant Industry of the United States Department of Agriculture, describes the modern methods employed to retard decay in orange shipments, and to improve the appearance of the fruit intended for the market. These include (besides the familiar refrigeration) the use of antiseptic washes which destroy organisms causing decay, the application of processes which retard natural biochemical changes in the fruit, and the application of blanching and polishing treatments which improve its appearance. The first step in the preparation of oranges for market is the determination of maturity. Because the earliest shipments command the highest prices, an incentive to collect immature and unripe sour fruit is ever present. Lack of restraint in this matter eventually kills the market, so that nowadays, maturity standards have been enforced by the larger fruit-producing companies. The standards vary for different kinds of citrus, and in different growing areas but they are usually based on measurements of the ratio between total soluble substances (mainly sugars) to acids in expressed representative juice. For Florida oranges, for example, the accepted standard ratio is 8 to 1, as determined by chemical tests. The chief organisms causing decay in citrus fruits are two species of Penicillium, viz: P. italicum and P. digitatum, known as the blue moulds. The latter is able to infect fruits only at places where the rind is injured, but the first may spread from points of contact in the pack. Careful handling and packing greatly reduce damage by these organisms. The use of antiseptic washes also aids materially in reducing their incidence. The particular wash which has given most satisfaction is an eight per cent solution of borax applied soon after harvesting and before blanching. Others are boracic acid solutions and solutions of sodium carbonate. Whilst the two last-named destroy blue mould, borax destroys stem-end rots as well. After treatment, the fruits should be washed in soft water. Blanching is usually effected by the controlled application of ethylene gas. The process has been thoroughly investigated, and the exact conditions of operation have been carefully worked out. They are sufficiently well-known to the trade not to require re-stating. Polishing is the final

process applied to oranges and other citrus fruits before packing. The fruits are passed across horse-hair brushes, and frequently some substance is added to increase the surface shine. Thus, rosin, added to the washing solution serves this purpose, but a mixture of paraffin wax with a mineral oil applied in a special machine furnishes a successful alternative. An emulsion of carnauba wax, used as a dip, is effective where brushing cannot be applied to delicate fruits, such as tangerines. The most widly-used polishing method, however, consists in brushing on to the fruits a small quantity of solid paraffin wax, introduced by pressing a bar of the material against the revolving brushes. (*Tropical Agriculture*)

Current Research

Foot-rot diseases of Piper betle L. in Bengal by W. McRae (*Ind. J. Agric. Sci. IV; 585*). In Bengal the foot rot diseases of betel vines are caused by three fungi, Rhizoctonia solani Kuhn, Sclerotium rolfsii Sacc., and Phytophthora parasitica Dastur. The major loss to vine-growers is due to the Phytophthora but just after the rains and in the early part of winter, the foot-rot is mostly due to R. solani. Only stray cases of S. rolfsii have have so far been noticed in this delta. Flooding seems to promote the disease to a considerable extent for in areas above the flood level and in years of scanty rainfall, the diseases do not cause so much loss. Warm summer temperatures are favourable for the growth of Phytophthora when it does the maximum damage; while slightly cooler temperatures favour the growth of R. solani. Growing the vines above the flood level, clean culture and timely application of two fungicides Bordeaux mixture and Kerol, control the disease. (*Author's abstract*).

Inheritance of characters in Cajanus indicus by B. B. Dave (*Ind. J. Agric. Sci. IV; 574*). The inheritance of flower colour, pod colour and seed-coat colour in Cajanus indicus has been described. The types of standard colcur studied are purple orange, plain yellow, yellow with red veins and yellow with purple veins, base diffused purple. Crosses of yellow and orange flowersgave orange in F_1 and a 3:1 ratio of orange and yellow in F_2. The F_3 segregations were in accordance with the expectations. Crosses of plain yellow and yellow with back of standard purple gave light purple with deeper veins in F_1 and a 3:1 ratio of purple to yellow in F_2. In certain crosses a 9:7 ratio of purple to yellow was also obtained. Crosses of yellow with back of standard red veined and orange gave in F_1

orange and in F_2 simple segregation of orange and red veined. Crosses of purple and yellow with purple veins, base diffused purple gave light purple with deeper veins in F_1 and a 3 : 1 ratio in F_2. Crosses of yellow with backof standard purple and orange gave in F_1 flowers with dorsal surface of standard purple and ventral surface orange. In F_2 the ratio of these colours on the dorsal surface of standard was 12 purple: 1 yellow. On the ventral side the segregation of orange gave orange and yellow in the ratio of 3 : 1. The types of pod colour studied are dark, maroon blotched and green. Crosses of green × dark gave dark in F_1 and a 9 : 3 ratio of dark, maroon blotched and green in F_2. In crosses of dark × maroon blotched × green, the segregations obtained indicated a monohybrid inheritance. The types of seed-coat colour studied are purplish black brown and white. Crosses of brown and white gave brown in F_1 and a ratio of 3 brown to 1 white in F_2. In crosses of purplish black and white the F_1 was purplish black and gave in F_2 a ratio of 9 purplish, black: 3 white with purple spots : 3 Brown: 1 White. Crosses of brown and purplish black gave purplish black in F_1 and a simple 13 : 1 ratio of purplish black and brown in F_2. Orange yellow flowers and purplish black seeds were completely linked in inheritance. Purple colour at the back of standard was closely linked with maroon colour of the pod. Complete linkage was also present between yellow flowers with back of standard having purple veins, base diffused purple and green pods. (*Author's Abstract*).

A study of the data of milk yields of various types of cattle obtained from the records of the government military dairy farms, Part II. Persistency of lactatation and its relation to age and level of production by K. P. R. Kartha (*Ind. J. Vet. Sci. Anim. Husb. IV; 124*). This paper contains an analysis of 812 lactations of cattle and buffaloes on the lines already followed in Part I. Here persistency is studied as a separate character in order to find out—(1) the range within which the values of persistency generally lie in a herd, and (2) the effect of (a) age and (b) level of production on persistency. The rate of decline is determined in the case of each individual lactation, and this value is made use of as a measure of persistency, an animal that declines most being least persistent and *vice-versa.* The values are found to lie within a range of 1 to 20 per cent decline per month, about 60 per cent of them being scattered round the mean within the range represented by the standard deviation. The means and standard deviations are as follows :—

	Rate of decline per month per 100 lb. milk.	
	Mean.	Standard deviation.
Cross bred cows.	9.210	3.960
Pedigree Sahiwal.	8.624	5.070
Ordinary Sahiwal.	11.725	5.770
Buffaloes.	9.733	4.119

1. Persistency and level of production—The rate of decline is found to increase with a rise in the level of production *i. e.*, the higher the rate of milk yield with which an animal starts in a lactation the less persistent she is. The increase in the rate of decline per 100 lb per month for each 100 lb. rise in the level of production is— .534 in the case of the cross bred; .568 in the case of the pedigree Sahiwal; 1.618 in case of the ordinary Sahiwal and .869 in the case of the buffaloes. A table is provided by means of which the percentage monthly decline at various levels of production can be found out in the case of the different breeds.

2. Persistency and age—The rate of decline is found to increase definitely from the first to the second lactation, showing that heifers are definitely more persistent than older cows. From the second to the third lactation the increase in the rate of decline is less marked, beyond this no definite age-persistency relation is indicated, the curves generally tending to be flat. The mean persistencies for each group though irregular follow the mean rates of yield very closely, indicating that persistency is influenced more by level of production than by age. (*Author's Abstract*)

A study of the data of milk yields of various types of cattle obtained from the records of the government military dairy farms, Part III. Prediction of milk yields. By K. P. R. Kartha, (*Ind. J. Vet. Sci. and Anim. Husb. IV;218*). This paper deals with some of the practical applications of the knowledge gained in Parts I and II regarding the rate of decline in milk yield with advance in the period of lactation. The most important of the applictions is the forecast of production of milk which is useful for a variety of purposes in dairying—in testing herds, in deciding when animals should be put to bull, in adjusting supply to demand, etc. A table is provided showing the ratios of 300 days'—yield to rate of yield in any month of lactation. By means of this table a complete lactation for a normal length of 300 days can be predicted from an incomplete one by multiplying the yield for any month by the ratio appropriate to that month. The peak of lactation is generally reached between the 3rd and 6th week after calving, and if the yield during these four weeks is known, the yield for a complete lactation of 300 days is obtained by multiplying the average daily yield during the four weeks by, 223.8 in the case of

specially bred Indian cows; 209.4 in the case of buffaloes and cross bred cows and 197.1 in the case of ordinary Indian cows. If the peak yield and rate of decline are known the yield for the whole lactation or for a part there of can be estimated either by arithmetical computation or graphically by drawing a lactation curve and computing the area under the curve over the desired period. Milk yield being the resultant of a series of factors, often beyond human control, a certain amount of error is to be expected in making an estimate. It is found that the estimated lactation yield is least liable to error when the estimate is based on the yield for the fourth month, the accuracy diminishing with distance on either side of this stage of lactation. Another useful application is in the comparison of herds or of individuals in the same herd when the lengths of lactation are not identical. In such cases it is necessary to know how much the animals would have yielded during the same period. A Ready Reckoner table is provided by means of which yields for different lengths may be reduced to a standard length of 300 days. (*Author's Abstract.*)

The loose smut disease of wheat (Vernacular "Kangiari" and some new methods of its control: By J. C. Luthra, and A. Sattar (*Agriculture and Live Stock in India Vol. IV; 504*). The loose smut of wheat occurs commonly in the Punjab and in some parts the damage caused by it is as high as 10-20 per cent. Simplified hot water treatment, single-bath method and two other new methods in which solar energy is used for heating water are described in the paper. A brief outline of the methods evolved is given below:—

1. Simplified hot water treatment method
   (*i*) Wheat is pre-soaked in water at 60°-85° F. for 4-7 hrs.
   (*ii*) It is then dipped in water at 120° F. for five minutes.
   (*iii*) Finally it is immersed in water at 127°-132°F. for 7 minutes.
   (*iv*) It is then thoroughly dried and sown immediately or can be stored till sowing time.

2. Single-bath method. Soaking of seed wheat in water at 105°F., 110°F., and 115°F. for 8, 6 and 4 hours respectively gives a complete control of the smut.

3. Sun-heated water method—A blackened cylindrical galvanized iron vessel, 30 inches in height and 16 inches in diameter, half filled with water, is placed in the sun in the morning on any bright sunny day in summer and seed wheat is soaked in it from 12 noon to 4 P. M. and then dried.

4. Solar energy method (exposure of pre-soaked wheat to the hot

sun)—Seed wheat is soaked in water for four hours (8 A. M. to 12 noon) on any bright summer day; then taken out and exposed to the sun for four hours (12 noon to 4 P. M.). Maximum temperature in shade at Lyallpur goes upto 120°F. and in the sun it has been recorded up to 131°F. in June. (*Author's summary*).

Studies on Calcium Cyanamide: IV. The use of Calcium Cyanamide and other forms of Nitrogen on grassland: By H. L. Richardson (*Jour. of Agri Sci. Vol. XXIV P. 491. 1934*) Ammonia added as sulphate of ammonia disappeared rapidly from a pasture grassland soil, while very little nitrate accumulated. In winter or early spring three-fourths of the added nitrogen had gone in less than 4 weeks. After the first fortnight there was little difference in the soil inorganic nitrogen from calcium cyanamide and from sulphate of ammonia. A moderate dressing of dicyanodiamide slightly reduced but did not inhibit nitrification; it did not appreciably retard the disappearance of inorganic nitrogen from the soil in winter. Winter applications of sulphate of ammonia produced less increase in yield or nitrogen content of repeatedly mown herbage than did spring ones. A late autumn application was almost as effective as a spring one. Calcium cyanamide in late autumn or early winter was on the whole less effective than sulphate of ammonia, but in spring the two were substantially equal. There was little evidence that calcium cyanamide was "slow acting" in comparison with sulphate of ammonia. Dicyanodiamide was practically inert so far as the effect of winter dressing on yield or nitrogen uptake was concerned. Under repeated mowing the response of the herbage to a 2 cwt. dressing of sulphate of ammonia (or other nitrogenous fertiliser) was rapidly exhausted. Later in the year there was a reduction in yield with spring sulphate of ammonia, resulting from a depression of clovers in summer through competition with the heavier growth of grass in the spring. The recovery of added nitrogen in the herbage was, at best, less than 40 per cent. This may have been due in part to its locking up by microbiological action in the soil organic matter (*Author's summary*).

Crop Forecasts

COTTON

Third Cotton Forecast 1934-35.

All India.—This forecast is based upon reports furnished by the undermentioned provinces and States, which practically comprise the entire cotton area of India. It deals with both early and late varieties of cotton and relates generally to conditions up to the beginning of December 1934. The total area sown amounts to 22,600,000 acres, as against 22,953,000 acres (revised) at this date last year, or a decrease of 2 per cent. The total estimated yield is 4,555,000 bales of 400 lbs each, as compared with 4, 658,000 bales (revised) at the corresponding date last year, showing, as in the case of area, a decrease of 2 per cent. On the basis of these figures, the average outtturn per acre of the present crop for all-India works out at 81 lbs, which is practically the same as at this time last year.

Central Provinces and Berar.—(19.2 per cent). The area sown is reported to be 4,251,000 acres (2,9[illegible]7,000 acres being in Berar), which is 2 per cent above the corresponding area of last year. The yield is estimated at 840,000 bales (583,000 bales being in Berar), which is 8 per cent greater than the estimate reported at this date last year. The average outturn for the province as a whole, is at present estimated at 77.3 per cent of the normal, as against 72.9 per cent reported at this date last year.

Cotton in Foreign Countries.—From information specially obtained by cable it appears that the production of the 1934 cotton crop of the United States of America is estimated at 9,731,000 bales of 500 lbs each (equivalent to 12,164,000 bales of 400 lbs each), as compared with 13,047,000 bales, the final estimate of 1933. The second estimate of production of the cotton crop in Egypt for the current season i. e. 1934-35, is estimated at 1,932,000 bales of 400 lbs each, as compared with 2,123,000 bales in 1933-34. The production of raw cotton in Manchuria this year is estimated at 159 million lbs (equivalent to 397,000 bales of 400 lbs each), showing an increase of 25 per cent over the last year's yield of 127 million lbs (equivalent to 317,000 bales of 400 lbs). From the latest available bulletin published by the International Institute of Agriculture, Rome, it appears that in Uganda, the area under cotton during the current season (sown up to the end of September, 1934) is estimated at 1,080,000 acres, as against 1,091,000 acres in 1933-34. The condition of

the crop at the end of September last is reported to have been slightly below average. The estimates of area and yield of cotton in China for the current season are placed at 6,747,000 acres and 3,498,000 bales of 400 lbs each, showing an increase of 10 and 7 per cent. respectively, as compared with the preceding season. (*The Indian Trade Journal*).

RICE

Second Rice Forecast 1934-35.

All India.—This forecast is based on reports furnished by the undermentioned provinces and States, which comprise 96 per cent of the total rice area in India. The forecast refers practically to the whole of the rice crop (early and late) in all the reporting provinces and states, with the exception of the summer crop and the crop in Coorg and Mysore information regarding which will be included in the Final General Memorandum to be published in February, 1935. The reports relate generally to conditions up to the beginning of December. The total area reported is 78,486,000 acres, as against 79,762,000 acres (revised) at this time last year, or a decrease of 2 per cent.

Central Provinces and Berar.—(7.6 percent)—The area sown is estimated at 6,782,000 acres (1,130,000 acres being in eleven Feudatory States), as compared with 6,881,000 acres (revised) last year. The yield is estimated at 2,081,000 tons (296,000 tons being the Feudatory States) as against 1,987,000 tons (revised) last year. The season was favourable and the crop did very well on the whole in the principal rice-growing districts. Excessive rain lowered the outturn slightly in a few districts where bumper crops were expected. For the province as a whole, the average outturn is estimated at 107 per cent of the normal, as against a full normal yield last year.

Rice crop in Foreign Countries.—From information specially obtained, it appears that the official estimates of the second rice crop of Formosa for 1934 place the area and yield at 935,000 acres and 23,49,000 bushels (or 657,000 tons), showing a decrease of 3 per cent in area but an increase of 6 per cent in yield, as compared with the same crop of 1933. The second estimate of the rice crop in Japan for 1934 is placed at 50,746,000 koku (or 7,117,000 tons), as compared with 70,847,000 koku (or 9,936,000 tons), the actual yield of last year. The total area and yield of the 1933-34 crop of Siam were 20,283,000 rai (or 8,113,000 acres) and 83,462,000 piculs (or 4,969,000 tons), as against 20,086,000 rai (or 8,034,000 acres) and 85,273,000 piculs (or 5,076,000 tons) in 1932-33. The area planted with the new crop in 60 provinces at the end of September, 1934, was

estimated at 18,109,000 rai (or 7,244,000 acres), as against 17,555,000 rai (or 7,022,000 acres) at the corresponding period of last year. The condition of the crop was, on the whole, reported to the fairly good at the end of september last. From the latest available bulletin published by the International Institute of Agriculture, Rome it appears that the estimates of the 1934 crop of the United States America are 737,000 acres and 751,000 tons, showing a decrease of 4 per cent in area but an increase of 5 per cent in yield as compared with the preceding year. In Italy, the area under rice this year is 314,000 acres, as against 316,000 acres in 1933. The yield of the crop is placed at 598,000 tons, which is practically the same as in last year. In Egypt, the area under rice in 1934-35 is 395,000 acres, which is 10 per cent less than in the preceding season (*The Indian Trade Journal*).

College and Hostel Notes

Janmashtami celebrations.—The birth of our Lord Krishna was celebrated on the 1st of September. It was conducted on a grand scale with the usual *eclat*. Mr. Athawale and others provided excellent musical entertainment in the night, which was attended by the students and some members of the staff. We offer our thanks to all those who helped us to make this function a success.

Ganesh Festival.—The festival was celebrated in the College hostel for ten days beginning from the 12th September. It was feared in the beginning that financial considerations would affect the scale of the celebrations. Very fortunately however this was not the case. The management had for its secretary Mr. R. S. Shivalkar, who has taken since his joining the College the keenest interest in all social activities of the College and who by his able management has raised the standard of the celebrations to a high degree.

During the festival week we had amongst us some of the eminent citizens of Nagpur. Mr. N. M. Deshmukh, Prof. Sinha, Mr. M. B. Niyogi, Swami Bhaskareswarananda, Rev. J. Z. Hodge and Mr. Rishikesh Sharma addressed us on different social and religious topics. Many of the popular musicians of the place entertained us with excellent musical performances.

The management thank all the members of the staff and students for their co-operation in bringing the festival to a successful close.

In the round of University tournaments our College teams had to play with the Spence Training College teams at Jubbulpore in Foot-ball, Cricket, Hockey and Tennis.

Our Foot-ball match was played on the evening of the 21st September. It was a rainy day and we had to play in the rains. The swift-running forwards of our side, notwithstanding the disadvantages of a slippery ground, rushed forward with all vigour and gave the Jubbulpore defence a lively hour. Our defence also played admirably and kept the opposing quintette under almost complete subjection. The game finally ended in a two goal victory for the Spence Training College Team.

Our game at cricket was admirable. The bowlers from our side by their tricks took one wicket after another and gave the opposing team a defeat by 47 runs. It was a two days' game. Special reference may be made to Mr. Kulkarni our batsman and bowler who has done a great deal to raise the score on our side. One and all in the team played a good game and the successful captain Mr. K. N. Thathode deserves special praise for the admirable performance of his team, in a game in which we, the humble tillers of the soil, are not expected to shine.

In the second round our team played against the Law College team at Nagpur on the Indian Gymkhana grounds. Here also our College put up a very strong fight. The match was very interesting and well contested though finally we had to give way.

In Hockey our College had to give way to the Spence team. The secretaries for the above games did their best to get their teams into form but an eleventh-hour attempt could not render the teams fit for a keen test.

Reference may also be made to Tennis where our champion Mr. S. A. Rashid put up a very strong fight with Mr. Osbourne of the Spence Training College although at the end he had to yield to his strong opponent.

The Spence Training College Debating Society arranged for a debate with our College during the visit of our teams to Jubbulpore to play the inter-Collegiate matches. The subject of the debate was 'The cult of Feminism is ruinous to human progress'. Messrs. T. P. S. Chaudhary and M. S. Nair were our two representatives, the former speaking for and the latter against the resolution. The resolution was moved by our College. The debate was a very keen one and the motion was finally carried by the house. Mr. M. D. Anadeo also spoke when the house was open for general discussion.

We take this opportunity to offer our sincere thanks to the Principal

staff and students of the Spence Training College for their cordial hospitality.

Calender of Operations.

FLOWERS.

By R. N. Sinha.

November.—Larkspur seedlings which germinated late, may be ready for transplanting. These may be planted 10 to 15 inches apart according to the height of the variety and nature of the soil.

Candytuft, allysum, mignonette etc. which were sown direct in the beds may be thinned out. The thinning may be done in two instalments.

Sweet Peas will be growing vigorously. They should be staked before they start leaning towards the ground.

Chrysenthimums and violets may be given liquid manure as often as possible. The principle in applying this manure should be "weak and often". Any gaps in the flower beds (failures in the seedlings transplanted last month) may be filled in as early as possible

Regular watering and occasional hoeing are the important points to be observed in flower beds. Water should not be applied over the head of young plants. It should be given to the roots from the sides or in between the plants, before the sun gets hot. Occasionally they may be sprayed overhead in the evening with a watering can having a fine rose.

Well rotten cattledung manure may be applied and forked in the canna beds, if possible, This will help them in producing better flowers in December, January February and March.

Roses will be in growing period. They should have proper attention towards watering and hoeing.

Chrysenthimums will need disbudding if bigger blooms are required.

Operations of budding and putting cuttings may be continued.

December.—Croton cuttings put in during the rains will have developed sufficient roots by this time and may be transplanted singly in small pots.

Like chrysenthemums, roses also need liquid manure and disbudding if bigger blooms are to be expected. Care should be taken in watering. Overwatering generally brings mildew on roses.

Coleus plants will be seen flowering. In order to preserve the

vigour of the plants and colour of the leaves the flowers should always be nipped off as soon as they appear.

Roses which were budded in the previous months will need special attention in removing the side shoots of the stocks.

Budding and putting in cuttings of different varieties of shrubs may be continued.

In order to encourage branching in sweet peas the growing tips may be pinched off once when the plants are 9" to 1 ft. in height.

Roses will be blooming freely to the end of this month. The flowers may be cut freely whenever required for use. "Cut and come back"—this is quite true in case of roses. In any case as soon as the flowers are over they shoud be removed.

January.—Carnations will start flowering. Attention should be paid to disbudding. Liquid manure may be applied to these with advantage.

Sweet peas will be more or less in full bloom. To have plenty and long season of flowers see that early seed formation is not allowed. This also applies equally in cases of all flowering plants, but more particularly in sweet peas carnation pansy etc.

Budding operation can be continued safely. Any failures of budding, done in the previous months, may be rebudded now.

Regular watering and hoeing of all the flowering plants should not be neglected.

Chrysenthemums will be getting over. The main plants may be cut out and removed. If necessary cuttings of these main stems may be prepared and planted in pots filled with fine sand or silt.

Sun-flower (small variety), Petunia coreopsis and portulaca seeds may be sown for obtaining flowers during summer season.

VEGETABLES

November.—The cold weather vegetables sown in previous months must be growing vigourously and should have regular watering and hoeing, otherwise the growth will have a check resulting in poor crops.

If possible Beet roots may be given a small quantity of salt as a manure and also liquid manure as often as possible.

The following vegetables may be sown now :—

Country Greens { Palak, Ambat-chuka, Cholai, Methi, Ghor

Onions
Brinjals
Radish
French beans
Lettuce

Cabbages and Cauliflowers may be earthed up and peas may be stacked before leaning or falling over the ground. Tomatoes will also need staking.

December.—Brinjals and onions left out in the last month may be sown now. If the seedling are ready they may be transplanted. In case of onions it would be worth while applying a small quantity of wood ashes in the ground before planting or after the seedlings has established and started growing.

Country green seeds (recommended in the last month) may also be sown in order to get successive crops.

January.—The following vegetables may be sown :—

Brinjal	Karela
Onion	Bottlegourd (Lauki)
Gawar	Pumpkin
Bhendi	Dilpasand
Country greens	Turai
	Cucumber

Old Kundroo vines may be pruned and if required fresh cuttings may be planted.

Departmental News

Leave on average pay for one month is granted to Mr. Laxmi Narayan Dubey, Extra Assistant Director of Agriculture, Chhindwara, in extension of the leave granted to him.

* * *

On expiry of the leave granted to him Mr. Laxmi Narayan Dubey, is reposted as Extra Assistant Director of Agriculture, Chhindwara.

* * *

On relief by Mr. L. N. Dubey, on return from Leave Mr. C. V. Bapat officiating Extra Assistant Director of Agriculture, Chhindwara, is posted to Drug in the same capacity, *vice* Mr. G. D. Mehta.

* * *

On expiry of the leave granted to him Mr. Maniram Singh Barker is reposted as Extra Assistant Director of Agriculture, Hoshangabad.

* * *

Leave on average pay for four months is granted to Mr. G. D. Mehta, Extra Assistant Director of Agriculture, Nagpur, with effect from the date on which he may be permitted to avail himself of it.

CORRIGENDUM.

A slight printing mistake has occurred in the article on statistical analysis in our last issue. At pages 13, 18, and 22, the sign of the square root seems to apply to the numerator only. It applies to the whole fraction.

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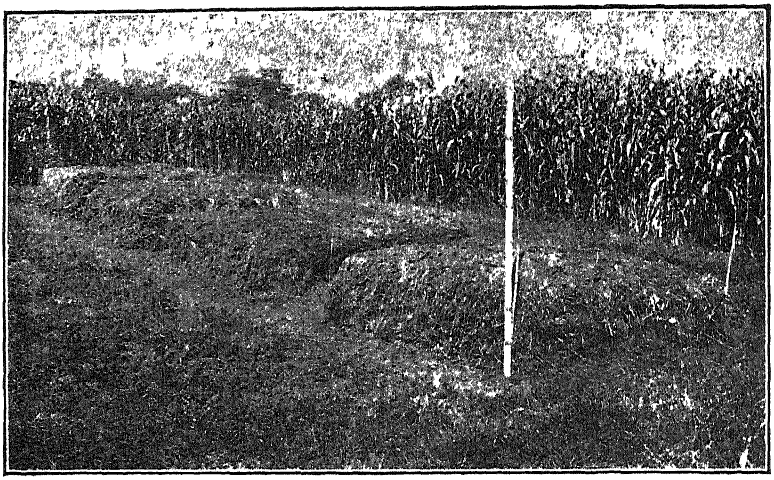
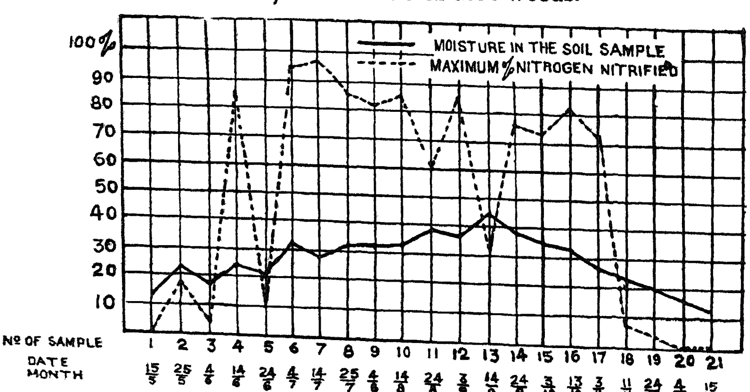


Fig. 1.

Fig. 2.

Figs. 1 and 2 showing heaps of partially decomposed cotton stalks, *Juar* stubbles and weeds.



SHOWING VARIATION IN THE WATER CONTENT AND AMOUNT OF NITRATE PRODUCED IN THE SOIL IN A PERIOD OF 8 WEEKS

Fig. 3.

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Editorial Notes

DEVELOPMENT OF RURAL AREAS.

It is a happy sign of the times that rural problems are attracting more and more attention of the people and of the Government. In the press, on the platforms and in the legislatures, the woes of the peasant and the ills of the countryside are the subjects for the most passionate eloquence. And we also hear of many new associations, like village uplift association, rural reconstruction units, village councils, village industries associations and so on, all brought into existence for the purpose of improving the conditions of life in the villages. The most noteworthy developement in this direction has been the provision of a crore of rupees in the Government of India's Budget for the current year for rural improvement work. When we consider the fact that there are about three quarters of a million villages inhabitated by over 300 million souls, the sum of ten million rupees might appear as but a drop in the Ocean. However, it is a good beginning and it is hoped that similar grants will be made from year to year. The money is distributed amongst the various provinces to be spent on schemes approved by the Government of India. The provinces are busy devising schemes for the utilization of this grant in the manner most appropriate to their requirements. The outlines of the scheme submitted by some of the provinces are known and they show the wide extent of the problem awaiting investigation and solution in the rural areas. The united

provinces Government have proposed the organization of village health units, the provision of marketing facilities for the farmer and the village artisan, the development of rural industries, and the training of young men in sanitation, agriculture and co-operation so that when they go back home, they will be in a position to work for the improvement of their respective villages. The Punjab Government on the other hand proposes to utilize the grant mainly for the consolidation of holdings, in the provision of drinking water and in the training of the depressed classes in useful industries.

In view of the fact that the grant is too small to start any comprehensive scheme of reconstructing the whole country side, it would be better to concentrate in building up model villages in each district or other convenient unit, so that they will serve as examples which others can see and follow. These model villages should be utilized as centres for education and propaganda which in course of time will leaven up the whole neighbourhood.

POPULATION RESEARCH.

The population problem is undoubtedly one of the most pressing economic problems of India and yet no systematic effort was so far made to study this problem except the decennial Census. It is gratifying to note that an organization called the Institute of Population Research in India has been established in Lucknow, largely at the initiative and enterprise of Dr. Radhakamal Mukherjee of the Lucknow University. The objects of this Institute are briefly to stimulate and organize population researches in the different provinces of India to co-ordinate such researches as are now being undertaken, to hold general and local conferences and to publish the results of researches and discussions at such conferences from time to time. Already several workers are carrying on research work under the auspices of the Institute and arrangements are being made to hold the first Indian population conference at Lucknow under the presidency of Lt. Col. A. A. Stewart, Director of the Institute of

Hygiene, during the *diwali* holidays at Lucknow. Researches on the following special problems are now being promoted by the Institute. (1) Population, food supply and vital statistics. (2) population crops and agricultural practice (3) population and trend of population (4) indices of agricultural productivity and population trend in the U. P. (5) standards of living, and cost of living indices (6) population dietary and nutrition (7) anthropometeric measurements of the inhabitants of U. P. (8) comparative study of the numerical valuations of different castes and communities (9) economic and vital decline of the primitive people of India and (10) migration, rural, interprovincial and overseas.

Original Articles

THE INDIAN SUGAR INDUSTRY

By P. D. Nair m. a., l. Ag. (Hon.)

Sugar is obtained from several sources. But it is produced on a commercial scale from two plants, sugarcane and beetroot. Of these sugarcane is undoubtedly the most important and ancient source. At the present time, of the total world production of sugar roughly two-thirds is from cane and one-third from beetroot. The production of sugar from beetroot is only a few decades old and has been developed largely by some of the European countries unsuited for the growth of cane. Sugarcane, on the other hand, comes to man from the misty past. India, particularly the Gangetic valley, is said to be the original home of sugarcane. References to sugar and sugarcane are found in the Sanskrit works of ancient Hindu writers. According to Hindu mythology sugarcane was produced by the supernatural powers of the sage Viswamitra as a heavenly food in the famous paradise (*Trisanku Swarga*) which he created for King Trisanku. Reference to sugarcane is found in the Atharwa Veda and also in the writings of the law-giver Manu and grammarian Panini. While Charaka, one of the founders of the Indian system of medicine, has described different grades of sugar according to their purity and usefulness for medicinal purposes.

The fact that the name for sugar in the various modern languages bears a close resemblance to the ancient Sanskrit word '*Sharkara*' goes to

show that the article is of Indian origin.* It is said to have been carried to the west from the Punjab by Alexander the Great, and to the far east as tribute to the Chinese Emperor by the people dwelling in the Indian border provinces. By about the 10th century A. D. sugarcane was extensively grown in most of the Mediterranean countries. In course of time it was carried to the far east and west and established itself in the islands of the Pacific and the Atlantic.

An Ancient Indian Industry.—There is evidence to show that about 500 years before the birth of Christ sugar was fairly well known in India and a sugar industry of some importance existed in Northern India. The people of the neighbouring countries, the Arabs, Greeks and Romans were, acquainted with this "honey made from cane which grows in India" and prized it for its medicinal value. It soon became an article of trade with the neighbouring countries. In A. D. 627 at the time of the conquest of Dastagerd in Persia, Indian sugar was among the spoils taken by the Byzantines. The Chinese became interested in the commodity and it is said that the Emperor Tai Tsung (A. D. 627-650) sent a commission to Behar to learn the art of sugar manufacture. By the 13th century sugarcane was extensively grown all over India. A Moorish writer by name Ibn-I-Batuta, who travelled over many parts of India at the close of the 13th century, mentions its cultivation at various places and refers particularly to the splendid *Pounda* cane of the Malabar coast. Another writer who is an authority on medicinal plants gives an account of the different varieties of canes grown in India and gives a list of the different forms of sugar manufactured in India during the Mahomadan period.

During the middle ages, in fact till almost the middle of the last century, India enjoyed a brisk export trade in sugar and the countries of nothern Europe were the principal buyers. Vasco-da-Gama mentions Calicut as an important centre of trade in sugar. The East India Company commissioned some of their earliest ships that sailed to the East Indies to secure some chests of sugar for trial in the English market. But one Edward Monox threw doubt on the desirability of complying with the Company's indents for sugar on the ground that it will not please the English palate. This shows that even during the middle of the 17th century sugar was not very much appreciated in Northern Europe as an article of consumption. The starting of sugar plantations in the countries of the Mediterranean popularised sugar in Europe and for long Indian

* Compare *Sakkara* in prakrit, *Schakar* in Persian, *Sukkar* in Arabic, *Saccharum* in Latin, *Zucher* in Italian, *Sucre* in French, *Zucker* in German and sugar in English.

sugar was in great demand. The East India Company carried on a vigorous trade in Indian sugar and this undoubtedly gave a stimulus to the industry, particularly in Bengal. The increasing consumption of sugar and the growing demand for it in Europe induced the Europeans to start sugar plantations on a large scale in their colonies and this was the death knell of the Indian industry. India, however, continued as an exporter of sugar till about the eighties of the last century; but the exports gradually declined and the position was ultimately reversed. By about the close of the 19th century India became an importer of sugar.

The decline of the Indian industry.—Several factors have contributed to the decline of this ancient industry of India. The East India Company's export trade in sugarcane gave a stimulus to the industry in Bengal for a time; but the restrictions which the Company imposed on the export from other provinces prevented the expansion of the industry in the other provinces. In the mean time the cane plantations in the colonies had attained their full growth and clamoured for protection against Indian sugar. Some of the European countries including England imposed discriminating tariffs against India. This dealt a great blow to the export of white sugar from India. But the establishment of sugar refining plants in Great Britain promoted trade in raw sugar for some time. There was a brisk export trade in this commodity between 1882-1892 with an average of 1, 145, 685 cwt. annually. This was short-lived and disappeared in a few years' time. "Thus there can be no doubt that a severe blow has been dealt to the Indian sugar industry which but for its immense resources and recuperative power might have been calamitous. Had England continued to purchase Indian raw sugar there is little doubt an immense expansion of the area of production and an enhancement of the yield would have been the natural consequences."*

Another important cause that led to the decline of the Indian sugar industry is the competition, first of European beet-sugar and later of sugar from Mauritius and Java. The production of sugar from beet first engaged the attention of some of the European countries towards the beginning of the 19th century and received active support from their respective Governments. With the aid of scientific research and generous bounties beet-sugar became a formidable rival to cane sugar and soon invaded the Indian market. The entry of beet-sugar into the Indian market was encouraged by a series of bad years, which culminated in the famine of 1901-2, when the indigenous production was low. A countervailing duty was imposed (1899) on the bounty-fed beet-sugar

* The commercial products of India, Watt. P. 959.

from Europe. Although this duty brought the Government some revenue, and undoubtedly reduced the imports of sugar from Europe, it did not give any protection to the Indian industry as the place of beet sugar was soon taken up by cane sugar from Mauritious Java and China.

Further, the Indian industry refused to expand to meet the rapidly growing demand for refined sugar from her cities and towns. The indigenous methods of refining sugar were very crude and wasteful. There were a few plants owned and managed by Europeans making sugar by modern methods. But by far the largest part of the cane crop was dealt with by methods unaffected by the contributions which modern science has made to industry. Of the total quantity of cane sugar produced in India over 95 per cent was turned out primarily as *Gur* or *rab*, and in the manufacture of these more of than one-third of the sucrose in the cane is lost. Though India had a large area under cane her outturn per acre was very low. In terms of sugar it was only one-third of Cuba one-sixth of Java and one seventh of Hawaii. Methods of cultivation were old. Cane was of poor quality and yield was low. No attempt was made to improve or increase production by the application of scientific methods. The colonial plantations, on the other hand, were on an industrial basis equipped with the highest skill and up to-date machinery. By scientific cultivation they were able to secure from three to seven times more sugar per acre and at much lower cost.

The beginning of the 20th century thus saw the Indian sugar industry in a completely paralized condition, partly owing to its own inanition and largely due to foreign competition and tariff discrimination. "Thus had India not only lost her European market but had become a field for European commercial enterprise in the provision of cheap refined sugar."* With the development of cheap transport facililties and the increasing consumption of white sugar amongst the towns-folk, the import of sugar into India increased by leaps and bounds. There was either no duty or only a small revenue duty ineffective to control imports. The following figures illustrate the rapid increase in imports during the early period.

1871-72	5,62,559	Cwt.
1881-82	9,82,262	„
1891-92	27,34,491	„
1901-02	55,65,272	„
1906-07	97,30,713	„

With the increase in imports the area under cane in India began to

* *Ibid.*

decline. The average area under cane during the eight years ending 1897-8 was 2, 818, 250 acres; but during the next eight years the acreage fell to 2, 429, 700 acres. (In fact, the former figure was never again reached till the Sugar Industry Protection Act of 1932 gave the industry a fresh lease of life). In subsequent years the import of sugar still further increased and constituted a great drain on the wealth of the country.

Imports of sugar into India.

	Value Rs.
Pre-war average.	1,31,758,000
War average.	1,47,048,000
Post-war average.	1,99,876,000
Average 1924-5 to 1928-29.	1,73,300,000

At the close of the war (1919-20) the position was roughly as follows. India had half the cane area of the world but her contribution to world production of sugar (cane) was only one-fourth. The annual consumption of sugar of all kinds in India was estimated at about 3¼ milion tons of which about 75 per cent was consumed in the form of raw sugar (*Gur*) and 25 per cent as refined sugar. The whole of the raw sugar was made in India, and of the refined sugar, about 3 to 4 per cent. The rest was imported largely from Java at a cost of 15 to 20 crores of rupees annually.

The import of such vast quantities of sugar into a country which was but a few years ago an important exporter of this commodity to other countries was an extremely humiliating state of affairs for the nation as a whole, particularly when all the conditions favourable for building up a prosperous industry existed in the country. She had half the cane area of the world, the art of making sugar was not unknown to the people and there was an enormous and expanding home-market. Further the sugar industry is very closely connected with Agriculture and is essential for the prosperity of the millions of cane growers of the country. In 1911 Mr. Madan Mohan Malaviya drew attention to the deplorable state of the Indian sugar industry in the Imperial Legislative Council. In the same year the Board of Argiculture discussed the mattter and made recommendations for the development of the industry. The first step in the direction of resusciating the industry was taken in the year 1912 when the Imperial Sugarcane Breeding Station was opened at Coimbatore. The excellent work done at this station under the able guidance of Dr. Barber, and later by Rao Bahadur Venkatraman in the production of improved varieties of cane is too well known to be recounted here. Some of the improved canes sent out from this station, such as Co. 205, Co. 210, Co. 213, Co.

214, Co. 223 etc. are now very popular with the growers all over India. Nearly 60 per cent of the area under cane in India at the present time is under these improved varieties which yield 100 to 160 per cent more than the ordinary canes. In the United Provinces and Bihar and Orissa improved varieties now occupy more than 80 per cent of the cane area. The economic value of these improved varieties can be seen from the fact that while the area under cane in India in 1934-35 (3,471,000 acres) represents only an advance of 17 per cent over that of 1931-32 the yield (5, 085,000 tons in terms of *Gur*) shows an increase of 54 per cent. In fact the work of the Coimbatore cane breeding station must be considered as the foundation on which the sugar industry of India is being built up at the present moment.

The great war gave a new turn to the whole problem. The disappearance of European beet sugar brought about an acute shortage of sugar all the world over resulting in an unprecedented rise in the price of the commodity. If India could not look to herself to supply her own wants she was faced with the alternative of either reducing her consumption of sugar or paying increased amounts to obtain it. Thus the need for developing the sugar resources of the country became apparent not only in the interests of India but also of the Empire at large. The financial stringency caused by the war induced the Government to increase the import duty on sugar. In 1916 the duty on sugar was raised from 5 per cent to 10 per cent *ad valorem*. In 1921 it was raised to 15 per cent and in 1922, to 25 per cent. The rise in price of sugar and the increase in import duty acted as a stimulus to the languishing industry and the producers took full advantage of these conditions. The area under cane in India showed a rapid increase and so also sugar production.

Area and yield of cane in India.

Period.	Area (acres).	Yield (Tons).
1901-2 to 1904-5	2,258,000	2,049,000
1905-6 to 1909-10	2,302,000	2,030,000
1910-11 to 1914-15	2,383,000	2,411,000
1915-16 to 1919-20	2,656,000	2,864,000

The close of the war was marked by a sugar boom in all cane growing countries, each country trying to take full advantage of the partial destruction of the European beet-sugar industry to reach its own optimum production.

*Progress of sugar industry during the post-war boom period.**
(In terms of raw sugar—1000 metric tons.)

Year.	World Production of sugar.	Cane.	Beet.	Percentage of Total.	
				Cane.	Beet.
1919-20	16,609	13,283	3,326	79·9	20·1
1920-21	18,119	13,216	4,902	72·9	27·1
1921-22	19,164	14,069	5,095	33·4	26·6
1922-23	19,413	14,084	5,328	72·5	27·5
1923-24	21,390	15,330	6,060	70·2	29·8
1924-25	24,883	16,567	8,316	66·5	33·5
1925-26	26,021	17,461	8,580	67·1	32·9

* The World Sugar Situation. League of Nations 1929.

India did not like to stay behind and there was a popular demand for developing the industry. In 1919 the Sugar Bureau was established at Pusa for collecting and disseminating information on sugar. But the problem was a very complicated one and it was thought necessary to conduct a thorough-going investigation into the cultivation and manufacture of cane sugar in all its aspects. Accordingly the Indian Sugar Committee was appointed in October 1919. The recommendations of the committee did not, however, produce any ostensible effect on the struggling industry. But the revenue expansion policy of the Government was an indirect blessing in as much as the increased import duty on sugar secured to a certain extent a protection against foreign competition.

The Act of 1932 and its effect.—Since 1926 the sugar industry of the world was heading to a crisis. During the boom that followed the war, production of sugar had outrun consumption and there was a glut

*World production and Consumption of sugar (1000 metric tons).**

Year.	Production.	Consumption.	Excess of production over consumption.
1926-27	24,859	24,790	69
1927-28	26,633	25,843	790
1928-29	28,898	27,479	1,419
1929-30	28,555	26,846	1,709
1930-31	29,579	26,934	2,640

* Review of the Sugar Industry of India 1952-33. *The Indian Trade Journal, July, 1934,*

in the sugar markets of the world with the result that prices had fallen to below remuneration level in most countries.

At the international sugar conference held at Brussels in 1930 an attempt was made to restrict production and assign quotas, but it failed. This precipitated a serious situation as far as India was concerned. If India did not take adequate steps to safeguard her interests her sugar industry stood the chance of being wiped out of existence for all time by the formidable sugar interests of the colonies. Further, the production of cane in India had expanded, as a result of the activities of the provincial departments of agriculture, from 30 million tons in 1924-25 to 43 milllon tons in 1931-32 if additional factories were not established to tackle this large output it meant ruin to millions of cane growers, particularly in the United Provinces and Bihar and Orissa. The seriousness of the situation was brought to the notice of the Government of India by the Imperial Council of Agricultural Research and urged for immediate and effective action. The Government of India referred the whole matter to the Tariff Board, who after a thorough inquiry into the question, recommended that the industry should be given adequate protection from foreign competition for at least fifteen years. India has several handicaps in the production of cane and manufacture of sugar. The climatic conditions over large areas growing cane allow only a very short growing period. The conditions of land tenure make large scale cultivation and intensive culture very difficult.. Over large areas the irrigation facilities are none too favourable. It would thus be impossible for India to build up an industry in the face of the fierce competition of the well-established sugar concerns of Java, Mauritius and other countries equipped with the most up-to-date methods and appliances. In Java the yield of cane is about 50 tons to the acre with 12 per cent sugar content, while in India it is only about 13 tons with about 9 per cent sugar content. The Hawaiian planters produce 7 to 8 tons of sugar per acre, the Javanese about 6 tons while the Indian production is only one ton to the acre. In these circumstances unless adequate protection is given capital would not be attracted to the industry. The Government accordingly passed in 1932 the Indian Sugar Industry Protection Act by which a duty of Rs. 9. 1 per cwt. (including 25 per cent surcharge) was levied on all imported sugar.

The act of 1932 marks a turning point in the history of the Indian sugar industry. The effect has been immediate and almost incredible. In fact, growers and manufacturers anticipated the event and were ready

with schemes of expansion. Within a few months of the passing of the Act, sugar machinery worth thirty lakhs of rupees were imported, which is about ten times the pre-war average. About 24 new factories were started within the first one year. The area under cane increased from 25 lakhs in 1929-30 to nearly 30 lakhs in 1931-32. During the same period the production of refined sugar more than doubled and the imports of sugar nearly halved. It was then anticipated that by 1935-36 the production of white sugar in India would be about 946,000 tons as against the annual consumption of 940,000 tons leaving an excess of 6,000 tons for export. Insect pests, unfavourable climatic conditions, and the ravages wrought by the earthquake in Bihar have prevented the expansion of the industry to the extent anticipated. Nevertbless the progress during the last five years has been wonderfully rapid. There are now about 142 factories making sugar by modern methods compared to 33 factories before the passing of the Protection Act. Between 1931-32 and 1933-34 sugar machinery worth 5.19 crores of rupees were imported, two-thirds of which came from Great Britain alone. Within five years the import of sugar has been reduced from about $9\frac{1}{2}$ lakhs of tons to less than $2\frac{1}{4}$ lakhs of tons and the drain of wealth from this country reduced from over $15\frac{1}{2}$ crores to less than three crores of rupees. In addition the industry has provided employment for several millions of cultivators and workers and has also provided an opportunity for the investment of a large amount of Indian capital, now estimated at about 20 crores of rupees which otherwise would have remained idle.

The following table summarises the progress made by the industry during the last six years:—

Year.	Area under cane. (acres)	Total output of sugar (*Gur*) (Tons).	Sugar Factories.	Production of white Sugar from cane and *gur*.	Imports of Sugar.	
					Quantity. Tons.	Value. Rs.
1929-30	25,13,000	27,52,000	27	1,10,918	9,39,600	15,51,00,000
1930-31	28,01,000	32,28,000	29	1,51,650	9,01,200	10,54,00,000
1931-32	29,71,000	39,75,000	33	2,28,120	5,16,100	6,01,00,000
1932-33	33,17,000	46,76,000	72	3,70,283	3,69,500	4,12,00,000
1933-34	33,08,000	48,72,000	115	5,54,000	2,61,000	2,70,00,000
1934-35	34,71,000	50,85,000	142	6,30,000	2,20,000	—

Fortunately, the Indian sugar industry started on its new career under very favourable circumstances. On account of accute economic depression land has become cheap. The restriction of sugar production in other

parts of the world has reduced the price of machinery. Interest is low, cane is cheap and a plentiful supply of it is available on account of the recent expansion of cane area.

The rapid expansion of the Indian sugar industry and the consequent closing of a potential market for exploitation, had serious effects on many countries. The blow was very severe on Java which used to supply 60 to 80 per cent of the Indian requirements. Her exports to India have been reduced from 809,700 tons in 1930-31 to 194,000 tons in 1933-35. On account of the difficulty of finding a market for her product Java is contemplating to reduce production by one-half. In the meantime she is making a serious effort to dump sugar into Indian ports at impossible prices to make the position of the infant industry difficult. The European countries with the exception of England have almost disappeared from the Indian Market.

The United Provinces and Bihar and Orissa are the most important sugar producing provinces of India and between them contribute over 82 per cent of the sugar produced in the country. United Provinces come first with 68 factories and 50.8 percent of the sugar production. The following table shows the distribution of the Industry in the country and the estimated production of sugar during 1934-35.*

Province.	Area under Cane.	No. of factories working.	Cane Crushed.	Sugar made.	Percentage of total production.
United Provinces...	18,39,000	68	34,90,000	3,00,000	50.8
Bihar and Orissa...	4,45,000	35	21,50,000	1,85,000	31.7
Madras. ...	1,22,000	10	2,30,000	20,000	3.25
Bombay. ...	1,12,000	6	1,95,000	19,000	3.2
Burma. ...	—	3	1,85,000	16,000	2.7
Bengal. ...	2,76,000	6	1,40,000	11,000	1.8
The Punjab. ...	4,62,000	7	1,00,000	7,000	1.15
Indian States. ...	—	7	3,60,000	32,000	5.4

* Compiled from the sugar production forecast 1934-35. The *Indian Trade Journal* Feb. 21, 1935.

A serious effort is being made to expand the industry in all the provinces under the shelter of the protective walls. The crop-planning conference which met at Simla in June 1934 suggested that Bihar and Orissa and Burma could increase their cane area by a lakh of acres each, Madras by 50,000 acres and that there was also room for expansion in Bombay, Bengal and Assam.

The Excise Duty.—By 1934 the sugar industry had made considerable progress. A large number of factories had sprung up and many more were under construction. Under the shelter of the protective walls, the factories were making fabulous profits and the industry was threatened with over-production in the near feature. There was a feeling that the consumers and the growers are being exploited for the benefit of the capitalist manufacturer. It was necessary to direct the industry on strong and sound lines so that it will develop efficiency and be able to stand on its own legs and face competition when the protective duty is removed at the end of the specified period. The Government therefore, decided in 1934 to impose an excise duty of Rs. 1-5-0 per cwt. of Indian white sugar. Government had another justification for this new imposition. The protective duty has put them to a loss of about 10 crores of rupees annually and it was thought that the excise duty will reimburse at least a part of it.

The Duty was stoutly opposed by the Industry. It was argued that an Excise duty was not anticipated in the Act of 1932, that the industry had not yet established itself, that it is an attempt to kill the infant industry to placate the British importing interests and that it is being imposed at a time of falling prices owing to keen internal competition. Those who justified the duty put forward the case of the grower and the consumer, who they said, were being exploited to benefit a small section of manufacturers. Of all economic questions protection has been the most fertile field for controversy. Protection is a necessary evil from a national point of view. All nations have resorted to it, and are still doing so, to build up their national industries. The sugar industry is an ancient national industry of India and closely allied to her greatest industry, agriculture. Raw materials are available in plenty and there is an unlimited home-market for the commodity. All arguments in favour of protecting an "infant industry" are applicable in this case. A little sacrifice on the part of the consumer for a short period is justified by the national character of the industry, the vast number of growers it benefits and the huge drain of wealth it prevents. It is undoubtedly possible to minimise the incovenience to consumers by fixing the

price of sugar with due regard to a reasonable margin of profits for the industry when once the industry has taken firm roots.

Research.—The establishment of a number of factories, the production of a large volume of sugar and a substantial reduction in the imports from foreign countries have filled the minds of most people with a complacent satisfaction, and they feel that the industry is now firmly established in the country. Far from it; there are many rocks and shoals ahead. The future of the industry depends upon how it solves, and bow soon it solves, the many problems facing it, the most important of which is perhaps research, resarch in the production of cane and in the manufacture of sugar. It is said that even with the present low prices Java is able to make profits. That is due to the efficiency of their methods, and their cost of production is the lowest in the world. Their up-to-date factories, highly trained staff, efficient research stations and elaborate organisation, have made the Java sugar industry a model one for the whole world. The production of cane in Java is largely under the management of the factories which employ highly trained agricultural experts to supervise cultivation operations and the cost of production is considerably reduced by employing labour-saving machinery wherever possible. Their research stations carry out thousands of field experiments every year and as a result of these experiments the production of sugar per acre in Java has been constantly on the increase and it has increased by 30 per cent during the last ten years. The theoretical limit of production is said to be about 160 tons of cane and 25 tons of sugar per acre, and they are striving hard to achieve it. The production of cane in India is very largely in the hands of small cultivators who follow time-honoured methods and the factories have no control over them. Although much useful work in the direction of improving cane has been done at Coimbatore and also at some of the provincial stations there is yet an unlimited field for work. Different varietes are required to suit the different climatic conditions found in this country. It is necesssry to increase the yield and sugar content of canes, and produce varieties which will mature at different times so that the factories will get a continuous supply of cane. The facilities for research at present available are not in proportion to the magnitude of the industry and progress is very slow. Proposals have been put forward for the establishment of an Imperial Sugar Research Station capable of tackling both the agricultural and manufacturing problems. It is very necessary that the manufacturers of sugar should associate themselves with this proposal and share the burden with

the Government. The Indian Sugar Mills Association must raise a research fund for financing research schemes on all aspects of the industry in the Universities and other research stations. Unless ample facilities are provided for continuous research the industry will not be able to stand on its own legs at the end of the period of protection.

Minimum price for cane.—Another serious problem arises from the fact that in India the grower of cane is different from the manufacturer of sugar. Each is dependent on the other, but the grower is the weaker party. In the first place he is not organised and secondly he deals in a perishable commodity which must be cut within the range of a few days and sold immediately after it is cut. The manufacturer tries to take undue advantage of this position and the poor cultivator is harassed in many insidious ways. To ensure a reasonable price for the cane to the cultivator legislation has been passed permitting Local Governments to fix minimum prices for cane for the use of factories and it has been taken advantage of by some of the provinces. But this is a problem which legislation can never solve. The manufacturer must realise that the industry cannot be made a success without the co-operation of the cultivator and that they should be given a fair and reasonable price to encourage them to grow better varieties. The relations between the grower and some of the old mills of the United Provinces and Bihar are said to be very cordial, but some of the newly started mills are the worst sinners in this respect.

Marketing.—With the growth of the industry it has become necessary to devise efficient systems of distribution which would prevent imports from foreign countries, regulate supplies and eliminate internal competition and price cutting. At a conference of the Indian Sugar Mills Association held at Calcutta last August it was decided to establish a sugar marketing board consisting of 25 representatives of sugar manufacturers who will appoint agents at the principal ports for the sale of about 30 per cent of the output of the factories at prices which can compete with that of the imported sugar. The factories will be free to dispose of the balance as they like. It is hoped that this arrangement will shut out imports, regulate supplies and secure a good price for the commodity. The marketing board was expected to function early in 1935.

By-products.—The utilization of the by-products of an industry is a very essential condition for reducing cost and increasing profits. The principal by-products of the industry are molasses and bagasse. There is a considerable demand for molasses in India for use in the curing of tobacco and in the past large quantities were imported from Java. But

with the growth of the Indian sugar industry the supply of molasses is more than the demand for it and the mills are finding it increasingly difficult to dispose it of. Molasses is a potential raw material which can be put to several uses such as the production of alcohol, mythilated spirit, yeast, potash, carbon dioxide etc. It can also be burnt as fuel in specially constructed furnaces. Molasses is a good manure being a cheap substitute for nitrogenous fertilisers. At a meeting of the sugar committee called by the Imperial Council of Agricultural Research, a sub-committee was appointed to consider the question of the utilization of molasses and they recommended the manufacture of alcohol and its admixture with petrol for motor fuel.

Bagasse is another by-product which is now used as fuel in the factories. It is capable of being put to more profitable purposes such as the manufacture of paper card board, insulating materials, artificial silk etc.

The problem of these by-products must be solved by the joint effort of the sugar factories as it is a problem common to all factories. When profitable methods of utilization have been found out it would be possible to establish subsidiary industries in places where there is a concentration of sugar factories.

Sugar making as a cottage industry.—The possibilities of developing the manufacture of white sugar by the cane growers themselves as a cottage industry on a commercial basis is worth investigating. More than three-fourths of the Indian cane crop is even now used up in the preparation of *Gur*. Again a good part of the crop is used in the manufacture of *Khandsari* sugar the production of which was estimated at about 275,000 tons in 1932-33. Thus about 80 per cent of the crop is even now used up in the villages. But the processes adopted in these indigenous methods are very wasteful. The Indian sugar Committee (1920) found that 34 per cent of the sucrose in the cane is lost causing a loss of 1,068,960 tons of sucrose for all India. The *Khandsari* process is also very wasteful. But it is certainly possible to improve these methods and reduce waste. Mr. Hadi in Bhopal found that with slight improvements 7 to 9.5 per cent of marketable sugar can be recovered by these processes and this compares very favourably with the percentage now recovered under the central factory system in India. The low overhead charge in such small undertakings make up the loss incurred by a low extraction percentage. The Tariff Board found that in the *Khandasari* method capital cost is estimated at 6.79 annas per maund of cane crushed as against rupee one per maund of cane crushed in the

centrals. These indigenous methods have still a place in the rural areas of India where communications are defective and the cane area small and scattered. The *Khandasari* industry is now employing several thousands of men, particularly in northern India and its distruction should as far as possible be prevented. The development of hydro-electric works and the provision of cheap power in rural areas opens out a wide scope for the development of sugar manufacture as a cottage industry. With cheap power it would be possible for the cultivators to work small centrifugals which would produce a better quality sugar and avoid waste.

EFFECT OF THE DECOMPOSITION OF GREEN MANURE ON THE GROWTH AND YIELD OF PADDY.*

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I. Introduction.—Field experiments on the utility of green manures for *rabi* crops, particularly wheat, have been carried out on the experimental farms at Nagpur and Hoshangabad since 1904 and 1909 respectively. While recording the results of these experiments, Allan (1915) emphasised the importance of an adequate interval, and a certain amount of rainfall between the date of the inversion of green manure and the date of sowing the seed of the succeeding crop. A biochemical study of the various factors concerned with the decomposition of green manures carried out by Bal (1922) also corroborated the views recorded by Allan.

Chemical research on green manuring in paddy soils was carried out for a long time in the Madras Presidency, the results of which are recorded by Vishwanath (1930) and which have been reviewed later by Smits (1931). It has been suggested that certain substances toxic to the rice crop are formed as a result of the decomposition of green manure which should be either removed by drainage water or destroyed by prolonged decomposition before the seedlings are transplanted. It, however, appears possible that any attempt, to drain off the toxic substances would result at least temporarily in the loss of a part of the useful manurial ingredients from the soil, and the latter alternative of prolonged decomposition may therefore prove more advantageous.

* Paper read before the Agricultural Section of the Indian Science Congress held at Calcutta, in January 1935.

Joachim and Kandiah (1929) in ceylon found that the green manure applied one week previous to the date of transplantation of paddy gave higher yields than when the same was applied five weeks before transplantation. Effect of other intermediate intervals like 2, 3, or 4 weeks was not, however studied by them.

It was, therefore, considered desirable to conduct experiments to find out the effect of green manure on the growth and yield of paddy when the former is applied to the soil, at the time of transplantation of paddy or one to two weeks prior to the date of transplantation.

II. Experimental.—Pot culture experiments on the growth of rice were carried out during the years 1931, 1932, and 1933. Green manure used was Sannhemp *(Crotolaria Juncea)*, and the soil employed in the pots was *matasi*, a light soil from the Chahattisgarh tract. The mechanical composition, calcium carbonate content, PH. value, and the exchangeable calcium content of the soil are given in table I.

Pots were arranged in four series as detailed below:—

(1) Green manure at the rate of 8000 lbs. per acre applied 14 days before transplantation.

(2) Green manure at the rate of 8000 lbs. per acre applied 7 days before transplantation.

(3) Green manure at the rate of 8000 lbs. per acre applied at the time of transplantation (according to the prevalent practice).

(4) Control, without green manure.

Quadruplicate pots were employed for each kind of treatment. Eight paddy seedlings were transplanted in each pot and the soil was kept submerged under water according to the common practice. When the grain was nearly ripe, watering was stopped, and the crop was allowed to attain complete maturity, and was afterwards harvested. The figures of yields obtained from the various pots under experiment recorded in table II, show the following:—

(*i*) Yield of both grain and straw has every year been found positively to correlate with the period which elapsed between the turning in of the green manure and the transplantation of the seedlings.

(*ii*) The total crop from the pots receiving treatment No. 1, described above is highest, showing an increase of 117·3 % over that obtained from the control pots.

(*iii*) The total crop from the pots receiving treatment No. 2 comes next in order, showing an increase of 81. 6 % over that obtained from the control pots.

(*iv*) The total crop from the pot receiving treatment No. 3 shows an increase of 49. 9 % only over that obtained from the control pots.

(*v*) All the pots receiving green manure irrespective of the periods of decomposition, give better yields than those obtained from unmanured pots.

Comparative growth of the paddy crop in the pot receiving different treatments mentioned above can be seen from figure No. 1.

The results recorded above show that in the rice-growing areas, wherever possible, green manure, if incroporated with the soil two weeks or at least one week prior to the date of transplantation, would give definitely better results than those obtained when it is incorporated at the time of transplantation of the seedlings.

The writer acknowledges his indebtedness and expresses his thanks to Mr. D. V. Bal, A. I. C., F. C. S., Agricultural Chemist, C. P. for the kind suggestion of the problem and much help in this piece of work.

III. Summary.—(1) An account of pot culture experiments on the effect of decomposition of green manure on the growth and yield of paddy has been given.

(2) Average yield figures of three years indicate:—

(*a*) that the pots receiving green manure two weeks prior to the date of transplantation give definitely larger yields than those obtained from the pots receiving green manure one week before transplantation.

(*b*) that the pots receiving green manure one week prior to the date of transplantation give larger yields than those obtained from pots receiving green manure just at the time of transplantation.

(*c*) that all the pots receiving green manure, irrespective of the periods of decomposition, give better yields than those obtained from unmanured pots.

IV. References.—Allan (1915) *Agric. Jour. India.*, X. 380—394.
Bal (1922) *Agric. Jour. India.*, XVIII, *2.*, 133—151.
Joachim and Kandiah (1929) *Trop. Agr.*, LXXII, *1.*, 253—271.
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Table I. showing the mechanical composition, $CaCO_3$ content etc. of the *matasi* soil.

Percentages on air dry soil.									
Coarse sand.	Fine sand.	Silt.	Fine silt.	Clay.	Moisture.	Ca CO 3	Water holding capacity.	P H Value.	Exchangeable calcium. Milligram equivalents per 100 grams air dry soil.
13.78	29.08	20.00	9.90	18.30	2.57	.08	30.0	6.5	6.85

TABLE II.—*Showing yields of paddy crop in grams from the pots receiving different treatments.*

(Plants per pot=8 ; Variety=*Bhondu.*)

Nos.	Treatment	1931					1932					1933					Total crop, average of 3 years	% Increase over control, average of 3 years	% Increase or decrease as compared with the treatment No. 3
		Grain	Straw	Total crop	Average total crop	% Increase over control	Grain	Straw	Total crop	Average total crop	% Increase over control	Grain	Straw	Total crop	Average total crop	% Increase over control			
1	Green manure applied 2 weeks before transplantatien...	33.6 38.2 34.0 40.2	43.2 48.8 40 9 46.4	76.8 87.0 74.9 86.6	81.3	+86.5	47.0 45.5 40.6 40.5	36.5 36.2 34.2 32.5	83.5 81.7 74.8 73.0	78.2	+108.5	40.5 43.7 42.2 41.8	32.6 35.6 33 0 32.4	73.1 79.3 75.2 74.2	75.5	+156.9	78.3	+117.3	+55.6
2	Green manure applied 1 week before transplantation ...	24.8 28.2 31.2 28.0	34.5 40.0 35.3 38.4	59.3 68.2 66.5 66.4	65.1	+49.5	38.9 28.8 29.7 35.0	24.0 24.9 25.2 28.4	62,9 53.7 54.9 63.4	58 7	+ 57.0	39.7 40.3 35.4 37.0	32.4 32.5 31.2 31.8	72.1 72.8 66.6 68.8	70.1	+138.4	64 6	+ 81.6	+28.4
3	Green manure applied at the time of transplantation ...	24.0 22.8 21.2 24.0	30.5 25.1 25.3 31.4	54.5 47.9 46.5 55.4	51.1	+17.2	24.5 23.6 23.3 25.4	21.0 21.7 20.4 24.7	45.5 45.3 43.7 50.1	46.1	+ 23.5	29.8 27.5 25.5 33.1	23.8 23.8 21.8 29.2	53.6 51.3 47.3 62.2	53.6	+ 82.3	50.3	+ 40.9	—
4	Control, no green manure ...	20.6 18.7 20.8 20.5	24.6 24.5 22.8 22.0	45.2 43.2 43.6 42.5	43.6	—	22.4 23.0 17.0 21.0	18.2 17.9 12.6 17.2	40.6 40.9 29.6 38.2	37.3	—	16.7 17.9 13.8 15.9	13.8 14.6 11.7 13.1	30.5 32.5 25.5 29.0	29.4	—	33.4	—	—33.6

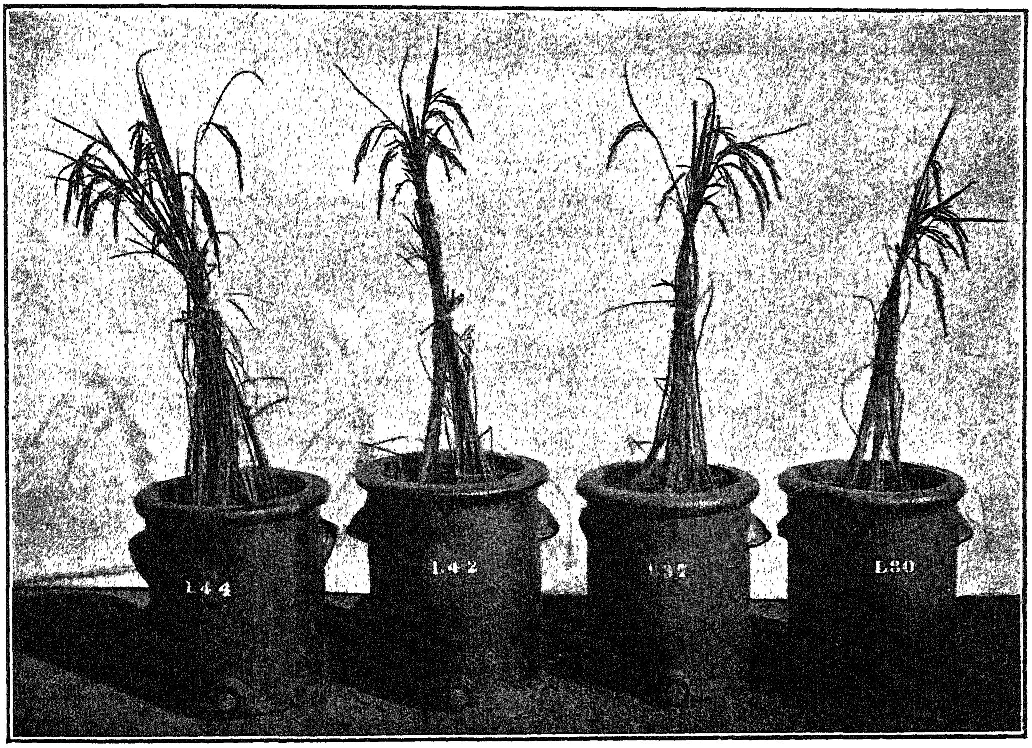

Figure showing the comparative growth of paddy in pots receiving green manure at different periods before the transplantation of seedlings.

Extracts

VERNALIZATION.

A NEW METHOD OF SHORTENING THE VEGETATIVE PERIOD OF PLANTS.

By N. Von Gescher.

The first workers who studied intensively the influence of light on the flowering of plants attributed the greatest importance to the intensity and the quality of the light. Later, particularly as a result of the work of Garner and Allard, from 1920, the fundamental influence came to be recognised of the relative duration of the day and night on the plant development, which phenomenon they termed "photoperiodism." According to these writers the periodicity of light exercised a fundamental influence on the rhythm of plant growth. Plants are adapted to this periodicity, which differs greatly with latitude.

Short-day plants, having an optimum reproductive development with a day length of 14 hours at most, may be distinguished from long-day plants, having their optimum with a day length exceeding 14 hours, while there is an intermediate group of plants independent of periodicity of light. To the group of short-day plants belong in general all those of tropical origin (cotton, soya bean, maize, millet), while all the cultivated plants of more or less northern origin are long-day plants, such as wheat, rye, oats, flax, etc. The correlation between the photoperiodic behaviour and the region of origin is so close that it would seem possible to deduce the latitude of origin of plant from its photoperiodic reaction.

Light is only one of the factors responsible for plant development. There are other factors which have a profound influence on the succession of the various phases of development, and more especially, on the transition to the fruiting stage.

In 1903 Klebs had already shown that the development of the reproductive organs results from quantative changes in the general and external factors regulating the development of the plant. According to him there are not specific external factors having a constitutive influence. The factors which decide vegetative growth and reproductive development are identical, but it is their intensity and reciprocal ratio which decide which form of development shall occur. According to Klebs the factors giving rise to flowering are an increase in carbon assimilation under the influence of light and a reduction of the concentration of certain

salts, particularly nitrogenous salts, in the soil. A certain proportion between the carbohydrates and nitrogen predisposes the plant to flowering. Tinker (1929) and Rasumov (1930) have carried our knowledge further with regard to the factors governing flowering and have proved that a certain periodicity of lighting applied to plants may give them a tendency to flower without, however, the tendency being manifested immediately.

It is here that the ideals of Prof. Lyssenko, of the Ukrainian Institute of Plant Breeding at Odessa, enter the field. What applies to light applies also to other factors influencing the rhythm of plant development. Lyssenko has in fact proved that the factors necessary for transition from the vegetative stage to the reproductive stage are not bound to any particular moment. Their influence may come into force at any moment in the development of the plant. The seed itself at the first incidence of germination is capable of receiving this influence, the effects of which will make themselves felt in the course of growth. Lyssenko follows the ideas of Klebs by making a clear distinction between growth, namely, increase in weight and size of the plant, and development, which is the transition of the plant to the successive stages, in other words, a qualitative change in the nature of the plant. He has developed the theory that the entry of the plant into a new phase depends on a complex of well-defined factors, no one of which must be lacking. In general it is the reproductive phase which is of interest to the farmer. In any particular area only those plants or varieties of plants are cultivated whose vegetative period is such that they are able to complete their reproductive phase in the local conditions of climate.

If it were possible to influence artificially the external factors, that is to say, the sum total of the factors determining the development of a given plant, and more particularly its transition from the vegetative to the reproductive stage, it would be possible to cultivate this plant in regions entirely different from those which are natural to it. This is one of the objects of Lyssenko's work.

He endeavoured first to ascertain these factors accurately. It soon became apparent that they differ in case of different species and even different varieties of plants. It goes without saying that the conditions for short-day plants must differ entirely from those for long-day plants. To enter into their reproductive phase, all plants of tropical origin require a combination of high temperature and short daily period of light.

It is particularly with regard to the nature of the influence of light that the researches of Lyssenko and his co-workers have introduced new knowledge, which if it is confirmed, will change the conception of

photoperiodism of the numerous workers, American and Russian in particular, who are concerned with this phenomenon. Lyssenko, in fact, has been able to prove that these influences on flowering are exerted by light and darkness themselves and not necessary by an alternation of the two. If it is necessary for a plant to pass through a period of darkness, it is sufficient for this period to be passed through in the seed during the earliest stages of germination. When the stages which require darkness are passed the plant obtained from such treated seed can be grown even under constant illumination; hence neither long-nor-short-day plants require photoperiodism. For growth and development of short-day plants light and darkness, but not the alternation of short day and long-night are necessary.

It is on these ideas based on a long series of experiments that Lyssenko has established the process termed " iarovisation " or "vernalization."* This consists in regulating the length of the vegetative period of a plant by artificially adapting it to a given environment by means of the combined action of temperature and light on the first phase of the growth of the plant, that is to say, on the germinating seed.

The practical interest of vernalization consists at persent in accelerating the fruiting season, thus making plants earlier in maturing. It thus allows of growing a spring-sown crop instead of a winter crop. By curtailing the vegetative period it is possible to extend the cultivation of wheat, cotton, soya bean and other plants into regions in which their cultivation had previously been impossible. The process may also be of fundamental importance in the combat of drought, by bringing the plants to maturity before the arrival of the summer drought. Plant breeders who are always anxious to cultivate as many generations as possible in the course of a single year, will be able to draw considerable benefit from it; further, since any factor which increases the earliness of harvest increases also the content in protein, vernalization will exercise also this very desirable effect from the standpoint of the baking quality of wheat.

With a view to encourage those interested to test these results for themselves, Lyssenko's process of vernalization of wheat will be described. Wheat requires to reach the fruitage stage a period of low temperature and long illumination. Spring wheat, for example, requires a temperature of 3 to 5°C. during 10 to 15 days. It will thus be necessary for these conditions, artificially produced, to exercise their influence on the germinating grain in order to give it the tendency to pass earlier from the

* For the etymological explanation of this term see the Monthly Bulletin of Agricultural Science and Practice, 1932, No. 8. P. 289.

vegetative to the reproductive phase. That is to say to make it earlier maturing.

The grain is first soaked with water to 15% of its weight: 100 kg. of wheat containing 13 to 15% of water will absorb 33 litres. This water is added in three applications. To absorb the first application about two hours are required, for the second 5 to 7 hours, and the third will be absorbed still more slowly. The grain must be turned with shovels to ensure the water being well mixed and to prevent the temperature rising above 15° C, the optimum temperature being from 10 to 15°C. When 3 to 5% of the grain has begun to sprout, which takes about 24 hours, the preparation is finished and the chilling process of vernalization proper begins. The temperature is lowered to 3 to 5°C. and kept at this leve day and night for 12 to 15 days. The interior and exterior temperatures of the layer of grain must be accurately controlled. After the treatment the grain must be dried by shovelling and winnowing.

Autumn wheat is vernalized at a temperature of 0 to 3°C. during 40 to 55 days. It is scarcely necessary to emphasise that during such treatment care must be taken to avoid mould. Experiments are in progress to obtain control of mould by chemical disinfection.

The process of vernalization elaborated by Lyssenko for cotton is extremely simple and consists only in increasing the temperature of the seed by self-heating to 30°. For soya bean the following method is proposed: soaking with water at the rate of 75 litres to 100 kg. of seeds, vernalization for 10 to 15 days at a temperature of 20 to 25°C. in the absence of light.

Vernalization of potatoes is effected by threading the tubers on wire and exposing them to continuous light for 20 to 30 days at 15 to 20°C. in a dry atmosphere.

It is interesting to draw a parallel between the work of Lyssenko and the recently published studies of G. Tallarico in Italy. In the course of his numerous experiments aiming at physiologically influencing seeds to increase yield, Tallarico submitted hard wheat for 14 days to the influnence of a temperature of 2°C. before sowing. This experiment, which was carried out at two different places during two consecutive years and repeated in three replications, gave the following averages:—on the control plots, 16.9 quintals per hectare; for the plots with treated seeds 19.6 quintals per hectare: or a gain of 2.7 quintals per hectare. It should be expressly stated that Tallarico, though independently approaching, as regards temperature and the duration of the period of treatment, the prescriptions for Lyssenko's vernalization, differs fundamentally in the fact that the

seeds were treated in the dormant stage, whereas Lyssenko on the contrary treats seed after germination has already begun. Also Tallarico mentions particularly that the effect of treatment by cold does not affect the vegetative period, but only the yield. In the vegetative cycle of plants the period of germination constitutes a critical stage, a period of instability and special sensitiveness to external factors. It is for this reason that during this period plants are particularly susceptible to artificial influences. In a further series of important experiments Tallarico stimulated seeds by a treatment with water without however repeating treatment with the low temperature. So did Lyssenko, he uses as little water as possible to obtain complete imbibition, which is checked at the moment when the first sign of germination is apparent. His numerous experiments have given the following average yields:—

	In Poor Soil.	In Rich Soil.
Untreated Seeds— (100)	100	100
Seeds treated with Water.	130	106

Thus there is observed a great increase in the crop as a result of treatment with water. This increase, however, depends to a large extent on the quality of the soil, as has been often observed in the experiments of stimulation by Popoff method. A comparison of the experiments of Lyssenko with those of Tallarico is very instructive. If treatment with water and treatment with low temperature each exercises a stimulating influence, and if on the other hand the effect of this stimulation depends on the nature of the soil, it is clearly demonstrated that the effect of vernalization may be due to reasons very diverse and independent of each other. This shows also the complexity of the phenomenon and the difficulty of analysing it.

Since the original works of Klebs on the subject, it has been recognised that the factors affecting plant development act indirectly through their influence on the enzymes. Demkovsky, one of Lyssenko's coworkers, has carried out exhaustive studies with a view to finding a biochemical explanation of vernalization. According to him enzyme activity increases gradually, and differently for the various enzymes during vernalization. The explanation of the phenomenon does not, however, become simple if the complex problem of enzymes is taken into consideration. The effect of vernalization of wheat may, however, be explaind in the following manner: the preparation for vernalization (soaking at 10°) activates the enzymes thus increasing the sugar content: the vernalization proper which follows and consists in reducing the temperature to 2° reduces respiratian and thus leads to a concentration of sugar which

predisposes the plant (in this case the germinating seeds) to flower. The factor "darkness" does not come into play, as in the case of short-day plants, because wheat, which is a long-day plant, is adapted to the periodicity of light occurring in northern regions. A similar explanation of vernalization may be made for short-day plants. This however is only a matter of unproved theory.

It would appear that varieties coming from distant countries are liable to react most strongly to vernalization and that the local varieties are less susceptible to its influence. In this case vernalizatian should serve to replace by an artificial process natural adaptation to external condition. It does not seem probable, however, that changing one or two factors such as light and heat, could suffice to ensure complete adaptation of the vernalized plant to environmental conditions differing profoundly from the normal conditions. It would thus appear unwise to try to use for vernalization and large scale cultivation foreign non-acclimatized varieties.

Studies of vernalization have been carried out in Russia on a huge scale. It will suffice to mention here that in 1932 they had already been extended to the 7,000 varieties of wheat constituing the international collection of the Pan Union Institute of Plant Breeding. Thousands of varieties of this collection had not been able to come into fruit in the regions where the experiments were carried out, or else fruited too late and produced stunted grain : sown after vernalization the same varieties proved earlier than the local varieties. Experiments carried out in 1932 on the collective Farms ("Kolkhoz") and the State Farms ("sovkhoz") over an area of 43,000 hectares gave for the most part favourable results consisting in an increase in yield of one quintal per hectare*

*Note—The following are some recent details of the results of these experiments and of certain others:—

1. In the spring of 1932 at Kharkov, Ukraine, 1, 427 varieties of wheat from Aserbeidjan (Trans-caucasia) were sown, vernalized and non-vernalized. On 5th July all the plots sown with vernalized seed had headed, whereas the control non-vernalized plots were still behindhand; in fact, at this date only 198 of the 1,427 varieties (or 13. 8%) had come into ear; heading increased until 6th August, when 649 varieties had headed; but the 778 other varieties never headed at all.

2. In 1932, also in the Ukraine, in 240 kolkhoz and 12 sovkhoz a total of 3,334 hectares were sown with vernalized seed. The gains in yield per hectare attributable to vernalization were as follows:—1 quintal in 127 kolkhoz, 2 quintals on 38 kolkhoz, 2.3 quintals in 9 sovkhoz and 3 to 9 quintals in 18 kolkhoz.

In 25 farms however vernalization produced no increase in the yield and in 35 forms it even reduced the crop, a failure which is attributed to the use of unsuitable varieties and to a defective application of the technique of vernalization.

3. In the organ of the U. S. S. R. National Commissariat of Agriculture, 29th September 1933, were published the encouraging results given by vernalization in the region of the middle volga where in 1933, 28,000 hectares were sown with vernalized seed; this year the early drought damaged particularly the non-vernalized wheat which thus gave a lower yield than the vernalized wheat.

4. In a preliminary note published in Scientific Agriculture Vol. XIII, No. 11, 1933, F. Gfeller and his co-workes of the Central Experiment Farm of Ottawa, Canada state that vernalization of cereals has in 1933 produced similar results.

Satisfactory results have also been given by the experiments with cotton. Those made in Ukraine in Northern Caucasia and in Irans-caucasia, have shown that vernalized cotton has accelerated flowering and maturation.

In consequence of these favourable results the U. S. S. R. National Commissariat of Agriculture, in agreement with the Directors of the regional agricultural administrations and the National Commissary of the Federated Republics, decided at the meeting of 12th October 1932 to sow vernalized seed, using primarily hard wheat, in the spring of 1933 over an area of 200,000 hectares, 100,000 of which were to be in Ukrain. The Ukrainian Institute for Plant Breeding gives advice in the varieties suitable for vernalization. Vernalied cotton is to be tested on an acreage of 3, 000 hectares, of which 2, 000 are in regions where cotton growing has been recently introduced. The Ukrainian institute has been made responsible for sowing in various parts of the Soviet Union, including the extreme north, the international collection of vernalized varieties of wheat, barley and bean which are available at the Leningrad institute for Plant Breeding. The Odessa institute has received thousands of enquiries concerning vernalization. Upwards of 25,000 explanatory notices about vernalization of wheat have been distributed and have been insufficient to meet the demand.

All this proves the importance attached in Russia to vernalization. In fact, if all the hopes founded on it were vain and the only remaining were the possibility of accelerating by 4 or 5 days the maturity of wheat, this alone would be sufficient to render vernalization of interest for a number of countries. In the light of the very numerous experiments carried out in Russia during 1932 it would seem certain that this end will at least be obtained. It is much to be regretted that the directions for vernalization were at first published only in Russian and Ukrainian and are not readily accessible publications, so that for a long time they escaped the attention of the world. The consequence is that up to the present it has not been possible to test the Russian results in other countries. The example of seed stimulation which caused such a stir a few years back and proved of very small practical interest, should make us wary of too greatly exaggerated hopes. However, the problem is sufficient-promising from practical points of view to deserve exhaustive and immediate trial.

It is to be hoped that the results of the important Russian experiments and of the control experiments now in progress in other countries, will enable vernalization to pass from the experimental field into general prac-

tice. It may then prove that vernalization is one of the most valuable of the technical inventions in the domain of agriculture of the last twenty years. (*International Review of Agriculture*, Vol. XXIV, No. 10).

THE STORY OF BUTTER AND CHEESE THROUGHOUT THE AGES.*

BY O. ST. J. KENT, B. Sc.

The story of butter and cheese takes us back to the early history of mankind, when dairying was in a very primitive state, and when dairy herds consisted of goats, cows, camels, mares, and sheep, owned by wandering tribes.

The milk from these animals was used as food, and entered largely, into the diet of these early people. But milk, under ordinary conditions does not keep very long, and it would have gone badly with these people, in times of scarcity, if they had not discovered some means of preserving the valuable nutritive constituents of milk. This they did by converting milk into butter and cheese. Just how long ago the first butter and cheese were made cannot be definitely stated, but the early writings give us some conception of the age of these two important articles. In the Scriptures, butter and cheese are mentioned on many occasions, and as far back as the Book of Genesis (18: 8), we read that "Abraham took butter and milk and the calf which he had dressed, and set it before them. "Other very early references appear in the writings of the Hindoos about 2000 B.C. The remarkable feature about all such early references is that the mention of milk, butter and cheese is, in every case, incidental and implies their previous use for an extended time.

Herd-testing an Ancient Custom.—While these two products were primarily made for food, they were utilised by different races for different purposes, and some of the uses to which they were put are very interesting, indeed.

In India, about 4,000 years ago, butter was well known, and besides being used as a food, it was also used for sacrificial purposes. In passing, it should be mentioned to the credit of the Hindoos of that period (i. e. about the year 2000 B.C.) that they valued their cows according to their yield of butter. Herd-testing is therefore a very old custom.

A Highly Developed Art.—The Greeks and Romans ate plenty of cheese but they did not use butter very much for food. This was probably due to the fact that cheese-making was a highly-developed art with the Greeks and Romans, whilst the making of butter was confined to Germany and

* Queensland Agricultural Jonrnal Volume VLII, Decr 1934.

other northern European countries. It was quite possible that, by the time the butter reached Rome and Athens, its flavour was any thing but pleasing, a factor that evidently influenced its consumption by those Mediterranean people. The Greeks and Romans used butter more as an ointment to enrich the skin and as a dressing for the hair. They also used it for skin injuries, and considered that soot from burnt butter was good for sore eyes. In Tartary, a piece of butter dropped into a cup of tea was considered very delicious by these people.

But as a 'Cure-all'.—In Spain, as late as the seventeenth century, butter was on sale in chemists' shops as a cure-all, to be used, as was specifically stated on the label for external use only ; Its use as a dressing or cooling salve for burns and bruises has been practised all through the ages, and even to-day we find butter recommended for this purpose. Less than 100 years ago, large quantities of butter were burnt as oil in lamps, in no less a country than Scotland. Times must have been hard for the dairymen in those "good old days," for Scotch folk certainly have the reputation of being thrifty.

To-day, butter is almost exclusively used as a food, and few of us would consider purchasing it for any other purpose. In its early history, butter was enjoyed as a food by comparatively few people. Those who did use it, seldom ate it fresh. The practice was to melt the butter before storing it, and it was usually employed in cooking, rather than as a spread. In India to-day a substance known as Ghee is essentially melted butter fat, and its preparation undoubtedly follows a method that has been handed down through many generations.

Butter and Class Distinction.—Apart form the uses already mentioned, the possession of butter and cheese by these ancient people was long regarded as indicating wealth, and served as a means of distinguishing the rich from the common people. Butter was often stored by burying it in the ground, allowing it to remain there for years, and very often a tree was planted over it so that it would not be disturbed. Under these conditions it turned deep red and was highly prized. The owner's wealth was determined by the quantity that he had stored up in this manner. Even at the present time, evidences of this old custom are to be found in certain towns of northern India.

In years gone by, the Irish people used to bury their butter in bogs, either for the purpose of storing it against a time of need, or to hide it from invaders, or for the purpose of developing a flavour. It has been said that the Irish and other peoples of early times, acquired a taste for rancid and

highly-flavoured butter; and this is supported to some extent by a quotation from Butler's Hudibras, which runs.

"Butter to eat with their hog,
Was seven years buried in a bog."

Samples of this Irish Bog butter are dug up from time to time even to-day, although the practice of burying butter ceased in Ireland about the end of the eighteenth century. Quite recently two lots of butter were found buried in a peat bog, one in County Leitrim, wrapped in a skin, and the other in County Tyrone, contained in a tub with perforated wooden handles. The colour of these butters was greyish white but they showed a few small specks of the original butter yellow in the interior. They were brittle and waxy and smelt like rancid tallow, and did not contain salt, Many such samples have been claimed from the bogs of Ireland, and archeologists have been able to show, from the nature of the decorations on their containing vessels, that these butters were buried, in some instances as far back as the eleventh century.

In modern times we reckon the wealth of nations in terms of butter and cheese, and we also bury these products but instead of putting them under the ground, we bury them in cold stores under conditions that are well regulated and hygienic.

Ancient Methods of Manufacture.—Butter and cheese in olden times were evidently not the choice flavoured, attractive foods which we know to-day. It should be interesting, therefore, to see what methods were adopted in ancient times for the manufacture of butter and cheese, and to compare them with modern methods. Let us consider the methods of making butter first of all. The principle underlying butter-making is a simple one. Milk or cream is simply agitated until the small fat particles unite to form butter granules. The process of agitation or concussion necessary to make butter is called churning, and the churning may be accomplished in two ways. In the first method the milk or cream is churned by rocking or swinging the churn. In the second method, the churn does not move, but the cream inside the churn is agitated by means of a revolving paddle, or some similar contrivance the churn inserted into the cream.

Both of these methods were adopted by the early primitive people, and they have been used in butter-making right down through the ages even to the present day. The only difference is in the apparatus employed, and the conditions under which the manufacture is carried out.

The earliest references to butter-making comes from India, and these were recorded in the sacred songs of the Hindoos about 2000 B. C. Accor-

ding to the historian Martiny, these ancient people made butter in a stationery type of churn. The milk was placed in earthen vessels and given a querling motion, either by beating it with the hands or by stirring it with a stick, flattened at one end. These were the forerunners of the modern dash-chuns, which are used on many farms and in many households to-day. In a modern dash-churn the dasher or agitator is either a piece of perforated wood or metal, which fits closely into a vertical churn.

The ancient Arabs and Hebrews used churns, of a rolling swinging or revolving type. Animal pelts were sewn up to hold milk, and thus constituted the churns. These were fitted to the bough of a tree, or in some other manner, and swung to and fro, after the fashion of a child's swing, until butter was formed. Sometimes a portion of the trunk of a tree would be hollowed out to form a churn and swung in a similar manner.

As civilisation progressed, churns of a better type were constructed, and to-day in our up-to-date factories we have huge barrel-shaped churns driven by machinery, which are capable of turning out a ton of butter in one batch. There is a vast difference in the size, design, and mechanical perfection of the modern churn, when compared with the crude ancient churns, but the principles involved are the same to day as they were 4,000 years ago. The modern churn has simply developed as a result of the gradual improvement of primitive equipment. It is easy to realise now, that butter obtained from churns made of animal skins could not have the same appeal to the consumer as does our modern butter, which is manufactured from pasteurised cream, and churned under excellent conditions.

The principles underlying cheese-making to-day are also the same as they were thousands of years ago. But in modern times the methods employed are much improved, and are more scientific. Cheese-making is a simple process to describe. Milk is made into a junket as a result of the addition of rennet. The junket is cut up into small pieces, which are warmed to enable the curds to separate from the whey. The whey is drained from the curds, which are then salted and pressed into the shapes which are so well known as cheese. When the first cheese was made, we do not know; but it must have followed closely on the use of milk of animals as food. The processes adopted in different countries differed slightly, with the result that cheese of many different names were soon known. To-day there are more than 500 different varieties of cheese listed. The commonest and the best-known cheeses have taken their names from the country in which they were first made. Thus we have

Stilton and Cheddar from England, Camembert and Roquefort from France; Gruyere from Switzerland, Limburgar from Germany, Edam and Gouda from Holland, and Parmesan from Italy. As people from these countries migrated to other countries, they naturally carried with them the knowledge of cheese-making peculiar to their native land, and established their methods in their new homes.

Cheddar Cheese.—The cheese which is made almost universally in Australia is called Cheddar cheese, introduced in the early days by settlers from England. Something of the history of Cheddar cheese may therefore be of interest. The first written record concerning this class of cheese is given for the year 1635, although it was evidently made for many years before that date. It receives its name from a little village in Somerest, where it was first made. At that time almost 300 years ago Cheddar cheese was in great demand, particularly when well ripened, and the cheese-makers found it difficult to supply that demand. In 1742 the price of Cheddar cheese was stated to be 6d. per lb. in England, a price which is rather interesting, in view of the fact that present prices are not so very different.

Progress in Manufacture.—In Australia some other types of cheese are being manufactured on a small scale. Swiss cheese or Gruyere cheese is made here now, and contrary to a somewhat common belief, it is made from cows' milk and not from goats' milk.

The most recent advance in the cheese industry is the preparation of a rindless cheese which is usually wrapped in tin-foil and attratively packed. This type of cheese is called 'processed cheese,' and is manufactured from Cheddar cheese by heating it in a special apparatus.

The great progress which the butter and cheese industries have made in the last thirty years or so has been due to many influences. The application of the Babcok test, which has enabled the farmer to be paid according to the butter fat which he sends to the factory, is amongst the most important. Another factor which had a tremendous influence on the dairying industry was the introduction of the farm separator. This machine changed the system of selling dairy produce entirely. Instead of the farmer conducting a milk business, it enabled him to conduct a business in cream, with its many obvious advantages.

The application of pasteurisation to butter and cheese has also had a profound influence on the development of this great industry, and last but not least, the application of scientific principles in regard to all phases of manufacture, has been instrumental in bringing butter and cheese to the standard of quality attained to-day.

INDIA'S COTTON PRODUCTION.*

BY R. D. MIHRA, M. A., B. LITT (Oxon).

One of the most important objectives in the prosecution of the Cotton programme in India, for some years, has been the encouragement to the growth, and the introduction, wherever possible, of long staple varieties of cotton, consistent with other commercial serviceable features relating to ginning and spinning qualities. This has been hastened partly by a gradual diminution in both world and home demand for short staple varieties of which India has been the principal grower, and partly by the realization that the continued dependence on any single consumer, as India stands in relation to Japan in the matter of her short staple varieties, is a very precarious prospect for the cotton industry as a whole and, on the heels of any legislative or diplomatic action on either side, may even prove fatal to the industry as it recently threatened to be. Efforts along these lines, however, have had an added incentive in the successful operation of a number of schemes designed to test the fortunes of better and long staple varieties, not only in the areas where formerly other crops were grown at considerable less profits, but in enormous new areas hitherto uncultivable but now affording perhaps the widest scope for the successful cultivation of long staple cottons that India can at present offer.

The Indian Central Cotton Committee.—I shall presently come down to the tangible progress achieved in the direction of introducing long staple varieties of cotton under various organized schemes in this country, but before doing so, I think it as well to say a word or two about the Indian Central Cotton Committee which in collaboration with the agricultural departments of various provincial government in British India and of the States, has been instrumental in carrying out very fruitful research into the growth and extension of improved varieties of cotton, by directly initiating and subsidizing organized undertakings throughout the cotton growing tracts in the country in one shape or other. The Committee thus forms a nucleus for an organized network of schemes, each operating along defined lines in the light of its unique needs, with definite ends in view but nevertheless conforming to a certain uniformity of aim and ultimate achievement.

The Present Outlook.—Nothing is more evident in the vicissitudes of the cotton industry in India in recent years than the gradual collapse of the fortunes of short staple cottons as a commercially profitable com-

* The Textile Journal, February 1935.

modity both in relation to the world and home markets. It has been increasingly apparent that before India can hope to maintain her position unassailed as one of the principal cotton-producing countries of the world, she must needs bring the growth and marketing of her cotton into line with the logic of world demands. Efforts have been made in the past dating indeed as far back as 1846, to introduce better types of cotton where regional conditions promised hopeful results, but lacking a central directive instrument for the guidance of corporate and co-ordinated activities, they have been necessarily incoherent and altogether adrift of the broad necessities of the country's industry as a whole. This state of affairs, however, came to an end with the inception of the Indian Central Cotton Committee under a Government of India Act, and by far the most important part of the work which the Committee has been doing has been the considerably augmented efforts devoted to exploring the possibilities of better varieties of cotton in regions given to the cultivation of inferior varieties, to be continually expanding the scope of this substitution wherever possible and generally to promote the storing and distribution of improved varieties of seed in areas where possibilities of such extension have been already estimated.

Research and Seed Extension Schemes.—This has entailed the setting up of various research schemes designed to throw light on the possibilities of new and improved strains in various cotton growing tracts of the country and the organization of Seed Distribution Schemes with a view to the distribution of carefully selected seed suited to the different cotton growing needs of different areas. Research work carried on in a network of stations throughout the cotton growing parts of the country has helped to build up an accumulated body of knowledge on the widely different needs, from region to region of cotton industry. It is scarcely perhaps realized abroad that agricultural conditions in India present such a bewildering variety of regional and climatic problems, that no single scheme, however broadbased, is able to handle, much less to tackle, successfully the variegated motley of agriculturl needs presented by any one commodity from one region to another.

In the Madras Presidency, a Seed Extension scheme is in operation, to help the Department of Agriculture in the distribution and extension of "Combodia" seed in the Coimbatore District where a farm area of 4,122 acres has been arranged for the growing of the improved strain. In Bombay "Jayawant" has been found particularly suitable for its southern tracts and through the vehicle of co-operative agencies and the Agricultural Department, its seed has been distributed in the Dharwar

District and parts of the Hyderabad State adjoining it. The seed depots in Surat which have been popularizing 1027 A. I. F. cotton seed in the adjoining areas, have been the means of supplying 1,660,980 lbs. of pure seed to outlying States like Rajpipla, Chhota Udaipur, Cambay, Jambughoda and Baroda, after meeting needs nearer home. In Khandesh the Indian Central Cotton Committee has popularised Comilla cottons, whose superiority to the local mixture has been definitely established. In Sind, on the right bank of the Indus, where cotton cultivation was never seriously attempted before, experiments carried on indicate that 4 F-18 (improved type of Punjab-American) is more suitable for the tract than 27 W. N. (improved *desi* type) and that soil and climatic conditions of Dadu district are more suitable for the cultivation of cotton than the former rice growing areas of the Larkhana District now brought under cotton cultivation. On the left bank of the river, too, the results of experiments carried on there indicate that 289 F-1 gives the best return and 289 F-2 the second best in the Southern Jamrao Tract, while in the Eastern Nara Tract 27 W. N. and 289 F-1 varieties give the best and the second best results respectively, both the tracts having been widely covered by the better yielding varieties. Coming to the Central Provinces we find the great fillip which *Verum* has received and a continually extending organization to distribute its seed with the result that the Agricultural Department was able to distribute during the year 1933-34 2,568 khandies) 20,13,312 lbs. of pure *Verum* seed, sufficient to sow an area of about 89, 560 acres.

Prospective Schemes.—No account of what is being done to bring ever-expanding regions of cotton under the cultivation of improved and long staple varieties through the agency of Seed Distribution Schemes is, however, complete without a mention of a number of new schemes which have been adumbrated, some of which are already well on the way to functioning.

In order to appreciate the extent of progress already achieved, and of the possibilities which lie ahead, it must be remembered that the opening of the Barrage Canal in Sind besides providing a source of perennial irrigation has helped to annex entirely new regions to the cotton growing areas of the country and experiments and trial tests carried on there have not only given a striking demonstration of the superiority of the cotton crop to others as an economic investment but have also promised abundant scope for the cultivation of long staple American varieties.

In the Left Bank Section, the extension in the cultivation of American cotton is proceeding apace, nearly 1½ lakh acres out of 5 lakhs of

acres under cotton are under American types, for the most part 289F and 4F varieties. In addition new tests with other high quality cottons like Sea Island 2-4, Boss III-16 and Ashmouni 37 are already in operation, and along side, the multiplication of the seed of improved varieties of cotton is being worked on a "Unit" system, each unit aiming to provide sufficient seed for 25,000 acres at the end of 5 years, finnally developed under one variety of improved cotton.

On the right bank of the river Indus, the cultivation of cotton is of recent origin and has followed the opening of the Barrage, in areas irrigated by the North Western and Dadu Perennial Canal Systems. During the past three years, the area under cotton on the Right Bank Tract has risen from *nil* to several thousand acres. At least 5,000 acres are being arranged for and practically all this area will be grown with improved varieties, viz., 4F-98 (in Americans) and 27 W. N. (in *desi* types).

Proposals for the financing of field tests of 1027 A. L. F. in the Navsari District of the Baroda State have been accepted by the Indian Central Cotton Committee to ensure a guaranteed supply of pure seed through the agency of seed stores in the Baroda State. The multiplication and supply of pure Banilla cotton seed in the Deccan Canals has also been taken in hand. In the Central Provinces and Berar, a number of types already in the possession of the Agricultural Department will be tested in pushing the scheme for the extension of long-staple cotton, in order that the area best suited to each of the types may be assigned to them.

It would perhaps be invidious to draw attention to the research activities which must precede any generalized conception of practical schemes of the types mentioned above and mention only a few of them to the exclusion of equally important others and it is as well that the scope of this article is answered without having to dwell at length on matters a discussion of which, relevant to the issues raised, is by no means essential for a proper appreciation of the outlook of the cotton industry in India.

AGRICULTURAL CHEMISTRY, 1910-1935.*

By Dr. E. M. Crowther,

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The agricultural science of the nineteenth century was predominantly chemical. Artificial fertilizers with the mineral theory of plant nutrition and the discovery of the main stages in the nitrogen cycle made it

* Chemistry and Industry, Vol. 54, 1935

possible to intensify production at a time of rapidly expanding home markets, and the work of the agricultural chemist was urgently needed. In the twenty-five years under review, the spectacular agricultural expansions took place in hitherto undeveloped areas, and owed their success primarily to the plant breeder, the veterinarian, and the engineer. Even in chemistry, the more dramatic developments bearing on agriculture cannot be claimed for agricultural chemistry; nitrogen fixation belongs to physical and engineering chemistry, and vitamins to biochemistry. Increasing specialization takes away scientific territory from the agricultural chemist, who has met this loss by travelling further a field and, above all, by closer contact with actual farming. In industry a laboratory may grow into a great factory exploiting a new process or product, but agricultural science must always find its problems and its applications in the work of multitudes of farmers working under an endless variety of conditions. A complex organization is needed to link science with practice for mutual benefit.

In Great Britain systematic provision for agricultural education began with an unexpected Treasury windfall, the "whisky money" of 1890. In the next ten years some eighteen agricultural colleges and farm institutes were founded and the first county agricultural organizers appointed. Official support for agricultural research had to wait until 1909, when the Development Fund of £ 2,000,000 was set up at the instance of Mr. Lloyd George. The Jubilee now being celebrated almost coincides with that for organized agricultural research. The schemes then initiated were greatly expanded after the war through funds provided as some consolation to farmers for the repeal of the Corn Production Acts. The policy throughout was to allot groups of problems to independent research institutions or University departments. Thus, listing only some of those in which chemistry plays a major part, soil and plant nutrition problems are studied at Rothamsted and the Macaulay Institute, Aberdeen, fruit production at long Ashton and East Malling, animal nurtition at Cambridge and the Rowett Institute, Aberdeen, and dairy research at Reading University and the Hannah Institute, Ayrshire. In addition the English counties are grouped administratively into provinces, each with an Advisory Centre at a University or agricultural college. Each centre has one or more agricultural chemists who may be called on to advise in any branch, and who generally conduct research in one or other division of the subject, e. g., soil survey, milk production, spraying.

In 1931 an Agricultural Research Council, modelled on the patterns

of the Medical Research Council and the Department of Scientific and Industrial Research, was set up to advise the Agricultural Departments and the Development Commission, which between them were responsible for the expenditure of £ 390,000 in 1931 on the agricultural research and advisory services.

The larger fertilizer manufacturers have their own experiment stations, several of which engage in general research and publish their results through the usual channels. The Imperial Chemical Industries Station at Jealott's Hill, one of the newest, has already made notable contributions and in addition has undertaken or supported a chain of investigations and critical field experiments on a variety of crops throughout the Empire and in other tropical countries. The International Superphosphate Manufacturers' Association established an experimental station in Hamburg and the German Potash Syndicate has a new and well-equipped station in Berlin-Lichterfeld.

In the Dominions there is generally a federal research organisation working through a chain of experimental stations research institutes, or universities. Most of the Colonies and Dependencies have one or more agricultural chemists who may have to perform the duties of a Government Chemist in addition to advisory and research work. General research in tropical agriculture is conducted in the Amani Institute, Tanganyika, and to Imperial College of Tropical Agriculture, Trinidad, and, until the recent earthquake, at Pusa in India. Where a single crop is of paramount importance, special research organizations have been set up, e. g., The Rubber research Institute of Malaya, The Tea Research Institute, St. Coombs, Ceylon, and the Gezira Agricultural Research Service in the irrigated cotton area of the Sudan.

Co-ordination and exchange of information between the widely separated workers is provided by local conferences as in East and West Africa, by the International Society of Soil Science, and by the eight Imperial Agricultural Bureaux, organized as a result of the Imperial Agricultural Research Conference of 1927. These were modelled on the lines of the Imperial Institute of Entomology and the Imperial Mycological Institute, which were founded before the war, and are intimately linked with the appropriate Research Institutes whose Directors are also Directors of the Bureau. The Bureaux are administered by an Executive Council, consisting of representatives of Great Britain, the Dominions, and Colonies.

In a short article there can be no attempt to survey the work of this ever-expanding organization. It is possible only to illustrate some

changes in practice and outlook, and mention one or two of the institutes with which the pioneer work was associated.

Soils.—With the renewal of international contacts after the war and the initiation of agricultural investigation in undeveloped areas, soil investigation was approached from a new angle. The older analytical or purely geological methods were of little value for virgin or extensively cultivable cultivated soils. Soils were therefore studied as complete units from the surface down to the scarcely altered parent rock, with the object of interpreting the composition and properties of soils in terms of their evolution. Under such conditions as prevail in the great continental plains of U. S. S. R., U. S. A., and parts of Africa and Australia, there is a regular sequence of characteristic soil types following the main climatic and vegetational zones. Within a single climatic zone, and especially in wetter and more mountainous countries the effects of the geological nature of the parent material become more obvious, and classification and mapping follow more empirical lines. But even here the attempt is made to define the types in such a way that later on they may be fitted into a more comprehensive scheme. Workers in the British Empire have unique opportunities for advancing this work and already a good start has been made. Soils in the West Indies may resemble those in parts of Nigeria, Malaya, or Australia, and problems which in any one of these countries appear academic and remote from practice, may provide the means of avoiding, if not of remedying, disastrous experiences which have been so common in the past. Many new schemes of agricultural development in the tropics have been jeopardized by excessive soil erosion through failure to appreciate the limits set by intrinsic soil properties. Some irrigation schemes have been abandoned through excessive alkalinity or salinity of the soil or absence of proper drainage, and every recent or potential scheme has a preliminary soil survey and an experimental farm. There is now a pressing need for facilities enabling soil workers in some of these tropical countries to acquire first-hand experience of the soils and research work in other distant ones with genetically related soils.

The main advance in soil chemistry during the last twenty five years has been the recognition of the importance of ionic exchange and the composition of the inorganic soil colloids. The essential facts of base exchange in soils were discovered by J. T. Way in 1850, but for fifty years or more pure chemistry could make little use of such troublesome observations as the liberation of calcium chloride and hydrochloric acid by the action of sodium chloride

on a soil free from water-soluble acids. Progress came only when Gedroiz in Russia, Hissink in Holland, and Sigmond in Hungary, showed that the amount of each of the exchangeable kations in a soil could be determined analytically by repeated extraction. Most fertile soils contain relatively large proportions of exchangeable calcium; in acid soils the calcium is replaced by hydrogen, and in some alkali soils it is replaced by sodium and magnesium. It thus became possible to estimate the "lime requirements" of acid soils and latter to use H methods and the theory of titration to measure soil acidity, and to explain why some soils needed much more lime than others. The recent revival of the long neglected practice of liming or chalking and the renewed interest in advisory work on soils are in large measure due to the confidence inspired by recommendations based on the simplest acidity measurements. On the other hand, it is realized that some crops, such as tea, flourish in acid soils and may be harmed by liming, whereas formerly chemists were prepared to recommend liming merely because the acid soluble calcium was low.

For a time, H values became a fetish and the subject was obscured by the over-enthusiastic, who took an indicator bottle on their walks abroad and published their findings. The soil revenged itself by upsetting their results. Very acid soils disguised themselves by absorbing such indicators as methyl red, or by liberating sufficient base by the inter action of manganese oxides with quinhydrone to raise the H by a unit or more.

The total exchange Capacity of a soil or the form of its titration curve with acids and bases proved to be of fundamental importance, not merely for acid or alkaline soils, but in the interpretation of the water relationships and the general physical properties of the soil. Crumb formation and cohesion in soils appear to be due to interionic forces and oriented water dipoles associated with active spots in the soil colloids. Many of the empirical methods of chemical and physical soil analysis prove to be closely correlated, and soil workers are engaged at present in discovering the ones of greatest significance. Up to the present the most useful index, after the exchange capacity and degree of saturation with bases, appears to be the ultimate composition of the colloidal clay, conveniently expressed as the molecular ratio of silica to alumina (or sesquioxides). There is some evidence from mineralogical and X-ray work that the inorganic soil colloids may contain only a few aluminosilicates in a series from montmorillonite (the characteristic bentonite mineral), through kaolinite to the final end products, gibbsite and various iron oxides. The inorganic colloids may be regarded as the weathering complex in soils, and it has been shown that the $SiO_2 : Al_2O_3$ or $SiO_2 : Al_2O_3\ R_2O_3$ ratio is

characteristic of the soil type. In general it is high for soils in arid climates, and low for highly leached soils. The more siliceous clays generally have higher exchangeable base capacities. The sesquioxidic clays lock up added phosphates in relatively inert forms. It appears that many of the more chemical and physical properties of soils will prove to be connected with the composition of the colloid complex-both inorganic and organic.

Fertilizers.—In countries with old and intensive systems of agriculture the consumption of fertilizers has changed in the direction of increased nitrogen and potash and decreased phosphoric acid, but this is balanced to a large measure by the rapidly increasing use of superphosphate alone in South Africa, Australia, and New Zealand. Ammonium sulphate has taken the place of sodium nitrate and organic products as the main source of nitrogen in mixed fertilizers. This, together with the production of higher grades of superphosphate and potash salts, resulted in an increased concentration of the mixed fertilizers, except where this was deliberately offset by adding inert fillers. It also caused increased "physiological acidity," for the nitrification of the ammonia or its direct assimilation by plants leaves an acid residue which inevitably increases the drain on the soil calcium. There are signs that fertilizer manufacturers are contemplating the addition of basic material to counteract these effects. Synthetic nitrogen led to several new highly concentrated compound fertilizers based on ammonium nitrate or ammonium phosphate, and it has been shown that these are as effective as the older mixtures, except for certain special soils and crops. The standardisation and economy in transport are obvious advantages.

The problem of relating manuring to the results of soil analysis is the subject of almost bewildering activity, and occupies a large fraction of the Continental and American journals on soils and agriculture. The excess of suggestions and comparisons of methods is itself an expression of their limitations. The methods in common use include pot-culture trials requiring the whole of a growing season, tests of the nutrient uptake by seedlings and fungi under laboratory conditions, and an almost endless variety of methods of extracting with strong and weak acids, salts, or water. Each method passes through a cycle of success in the easy extreme soils of long-continued manuring experiments and neglected land, more qualified success in commercially cultivated soils similar to those for which it was first standardized, and finally, comparative failure in other countries or on widely different soils. Each method needs to be standardized and used within prescribed limits, but it is not possible to

define these limits without adequate field trials. Much of the confusion and uncertainty is due to the failure of the older technique of experimenting on a few plots, often in systematic arrangement. One of the greatest advances in agricultural science during the last twenty five years is the development of an accurate and convenient statistical method of analysing agricultural data and of planning and testing the results of field experiments. Methods based on R. A. Fisher's "Analysis of Variance" are rapidly spreading throughout the world and it is now being realized that no agricultural experiment has much value unless its results are coupled with a valid estimate of their precision. The technique is applicable to the ordinary commercial farm and has been employed for almost all crops, including fruit trees and rubber. Research and advisory services now need to be supplemented by adequate provision for field experimentation under commercial conditions. Useful beginnings have been made by the voluntary "Experiment Rings" in Germany, and above all, in Java. Here the sugar Experiment Station of Pasoeroean carried out 16,400 field experiments with 10 to 12 replications on about 500,000 acres of sugar cane in 1928 to 1932. Many thousands of these experiments tested different amounts or combinations of fertilizers.

Crops differ in their nutrient requirements. Thus, fruit trees will respond markedly to potash both in yield, disease resistance, and quality, on soils for which cereals are unresponsive. Sometimes elements not commonly included in mixed fertilizers are essential for special soils and crops. Thus, in the highly organic soils of the Florida Everglades a small dressing of copper sulphate makes all the difference between good crop growth and complete failure. On some neutral sandy humus soils in Northern Europe and Great Britain, oats suffer from a characteristic disease due to manganese shortage. Tomato and sugar beet crops may need boron, and it is known that boron must be supplied to obtain good growth of many leguminous plants in sand or water culture.

Organic manures.—Increasing mechanization removes one of the many sources of the bulky organic manures used by market gardeners to build up intensive systems of cropping and by farmers to maintain the fertility of their fields. Before the war Norfolk and other counties had a carefully balanced combination of arable farming with livestock fattening. The stock produced the manure to grow the crops to feed the stock. Increasing labour costs, decreasing prices, and the long economic lag in this method of farming called for drastic changes after the war. Alternative methods of maintaining soil organic matter and utilizing straw were needed. The Adco method developed at Rothamsted

for rotting straw by ensuring a proper balance of carbon, nitrogen, and base showed one way. It has been taken up abroad, especially in the tropics, but at home it found its most popular application in the treatment of garden refuse. Methods are being worked out for utilizing straw directly by controlling its decomposition in the soil by the addition of suitable sources of nitrogen.

At Indore in India, the ancient practice of composting plant refuse with soil, animal excreta, and lime was critically examined and standardized in the light of modern biochemical work. The process provides a valuable manure from local wastes in districts where the need for manure is particularly acute. It has had conspicuous success in preliminary trials in Africa and, quite recently, has been adapted to deal with human excreta and town wastes.

The alternative to fermented manures lies in the proper utilization of crop residues. For perennial crops, such as rubber and tea, the theory and practice of green manuring and cover cropping are well developed, but for annual crops requiring frequent cultivations there are many unsolved problems. Experiments at Woburn showed that summer green crops before wheat failed to maintain the fertility of the soil, probably, because the nitrogen in the green crop was lost by drainage and as gas before the wheat could utilize it. The dangers of excessive clean cultivation have been abundantly demonstrated in many parts of Africa and Asia by the total failure of conventional European methods of cultivation to maintain soil fertility under tropical conditions. Some efficient modification of the native system of shifting cultivation is required for social and administrative reasons, and it is now increasingly realized that it must be sought by a sustained programme of experiment and fundamental research.

Grassland.—In the nineteenth century basic slag was used to build up the fertility of some of the poorest pastures, but the management of the better class of land received little scientific study. In 1881 R. Warington wrote simply that "young grass is much richer in albuminoids and contains a smaller proportion of indigestible fibre than older grass and is consequently more nourishing." The Rothamsted workers saw in that conclusion a sufficient explanation of good grass land management and left it at that. The conclusion has been confirmed and elaborated in innumerable investigations since the war. It was realized that our total imports of grain and feeding stuffs were unduly rich in carbohydrates and that the missing protein must come from the young grass of pastures. Methods were devised at Hohenheim, in Germany, developed at Cam-

bridge and Jealott's Hill, and applied with conspicuous success in New Zealand for increasing the total annual production of this young grass by a system of intensive rotational grazing of pasture treated repeatedly with fertilizers. Attempts are also being made to conserve young grass by drying and by ensilage. The latter process is facilitated by adding mineral acid (the patented A. I. V. process) or a convenient source of carbohydrate which will rapidly yield acids by fermentation so as to prevent putrefactive decomposition by bacteria.

Animal Nutrition.—Metabolic experiments and critical feeding trials have improved the reliability of feeding standards and facilitated the systematic rationing of farm animals. New foodstuffs such as fish meal, soya bean meal, lucerne meal, and sugar been pulp have been added to the farmer's raw materials. On millions of acres of grazing land throughout the Empire the limiting factor to stock rearing is the low mineral content of the pasture. Sir Arnold Thieler and his colleagues at Ondersterpoort in South Africa showed that cattle on the phosphate-deficient pastures of the veld suffered not merely from osteomalacia and rickets through absolute shortage of phosphorus, but indirectly from acute botulism and other diseases resulting from their eating infected carcasses in their craving for a missing food. The Rowett Institute and workers in New Zealand and other parts of the Empire have recognized other deficiency diseases, e. g. "pining" in sheep on some Scottish hill pastures, and "bush sickness" in cattle on certain New Zealand pastures on volcanic ash soils. The latter is presumably due to an iron deficiency, for it can be controlled by licks or drenches containing certain forms of iron oxide, or even by allowing the stock to "eat dirt." The difference in iron content between some "bush-sick" and healthy pastures appeared to depend on the readily soluble iron in the soil contaminating the herbage rather than on the iron content of the herbage itself, In this country the importance of adequate supplies of lime and salt for pigs is now generally recognized. At one stage it was argued that many of the alleged vitamin deficiencies might prove to be mineral deficiencies, but it is now realized that both classes of accessory food factors are essential for health in animals and man, and further, that their importance is not limited to the isolated cases where the symptoms are so acute as to be readily recognized as definite diseases.

In domesticated animals, as in man, many disorders are due to general malnutrition. In Nigeria the growth and reproduction rates of native cattle on open range were improved enormously by adding a meal of beans when the animals were brought into their shelters at night.

When the natives can be educated to cultivate crops for stock and to use manure for these crops, revolutionary changes in agriculture and standards of living may be expected, but first proper methods must be devised and tested.

THE MENACE OF PLANT DISEASES.*

A big factor in production costs.

It is sometimes suggested that since the markets of the world, and from time to time, even local markets, are glutted with supplies, it would be a good thing if plant diseases were allowed to affect crops more severely. This may be satisfactory if it applied only to the 'other fellow' in another part of the world, but it is very faulty logic to apply to the local situation. Droughts, pestilence and disease, no doubt, will cause havoc in crops in the future, even as some of them have done in the past, but they will not do so to the farmer's profit. It does not help to reduce supplies by methods which increase cost of production, and the message which the Department of Agriculture has given for so many years past is that methods should be adopted which increase the profits per bushel of wheat or per case of fruit harvested. Plant diseases may affect crops not only by causing reduction in yield, but frequently also by causing serious reduction in quality.

Diseases Cause Enormous Losses.—Some of the effects of plant disease in this State are still so well known that it is hardly necessary to refer to them. Wheat rust has caused millions of pounds worth of damage in crops grown in this country. The 1916 outbreak resulted in a loss of £ 2,000,000, and many will remember the damage in individual crops in 1930. Vinegrowers will remember that downy mildew was unknown in New South Wales prior to 1918, and in one year caused a loss of £ 40,000. The proper study of plant disease dates back only to 1835, when a mysterious disease destroyed the potato crops in Europe and resulted in the Irish famine and the death of a quarter of a million people in Ireland alone. The disease was the now familiar Irish blight or late blight, unknown in New South Wales before 1919, and although control measures have been known for many years, the tomato strain caused extensive losses in tomato crops in our coastal areas only last season.

Cost of control is heavy.—We have recorded more than a thousand plant diseases in New South Wales, and it would appear that very satisfactory means of control have been developed against most of the more serious

* Report of an Address by Dr. R. J. Noble, Biologist, in the Agricultual Gazette of New South Wales, Vol. XLVI, Part I, January 1, 1935.

ones. Yet in many cases this involves a careful, systematic application of sprays or other treatments, and the costs involved are enormous. Careful surveys in other countries have shown that the cost of application against many fruit pests and diseases represents 30 per cent of the cost of production. If, as it seems likely, a similar position exists here, then spraying costs for protection of the apple and pear crops in our eastern States are represented by some £ 900,000 each year. We cannot hope for ready solution of this problem from the plant breeders, although they have done so much in other directions.

Wheat diseases and the barberry. Plant breeders have produced wheats which are highly resistant to the scourge of black stem rust. The problem has never been a simple one, as although it was thought, at first, that stem rust was a single disease. It is now known that there are approximately one hundred varieties of strains of the fungus. Some strains affect wheat varieties which are not injured by other strains of the rust fungus. Seven such strains have been recorded in New South Wales in the past, although, for the time being, some of them seem to have disappeared.

For many years it was thought that the rust in Australia was carried over from season to season only in self-sown plants and in grasses, but we now have proof that the full complicated life cycle can occur here just as is the case in Europe and America. This was observed last year in the Bath-rust district, when a barberry bush was found infected with wheat stem rust. This is fact of special importance, not so much because barberry bushes will initiate early epidemics of wheat stem rust, but because they provide the means for developing new and possibly more virulent strains of the wheat stem rust fungus.

I have more than once stressed the need for regulatory measures against the barberry, but the responsibility lies with growers in the cooler districts, because the mere proclamation is of little assistance unless growers accept the responsibility of seeking out and destroying the barberry or in replacing it with ornamental relatives which are not susceptible to the disease. This is a matter of concern to all wheat growers, for the wheat crops of this State are subject to the very real menace of entirely new strains of the stem rust fungus.

A full description of barberry in its relation to stem rust is included in the leaflet "Rust Diseases of Cereals," a copy of which will be supplied free on application to the Department.

Virus disceses.—The facts in relation to the bunchy top disease of bananas are still quite fresh in our minds. In 1922 about 5,000 acres were

planted to bananas, but owing to the development of bunchy top the area was reduced to 1,500 in 1925, and now, after elucidation of the disease and the development of suitable control measures, there are 21,000 acres under cultivation. At one time bunchy top had practically annihilated the banana industry 650,000 bunches were produced in New South Wales in 1922, and this figure fell to 91,000 in 1925. The disease is caused by an infective agency which is present in the sap of diseased plants and which is termed a virus.

There are many hundreds of different virus diseases, and they represent a very distinct menace to crop production throughout the world. In addition to bunchy top, some locally familiar examples are woodiness in passion-fruit, mosaic in beans, leaf roll in potatoes, and spotted welt in tomatoes. There are times when it seems to me that we are perilously placed on the edge of a volcano, for this is a group of diseases which is constantly expanding, and it is possible that we may yet encounter even more serious difficulties with them than has been the case in the past.

Control sometimes extremely difficult.—Fortunately for banana growers, bunchy top is not carried over in unrelated plants; under our conditions it appears to affect the banana only, but a disease like spotted wilt, and probably, also woodiness in passion, affects an exceedingly wide range of plants which botanically are not related to one another. Some virus diseases are carried in plants which show no sign of disease, yet when insects feed on them and transfer the sap to other plants the virus becomes evident or new virus combinations are developed which are more serious than either virus disease acting alone.

In spite of the good work done by potato-growers in eliminating leaf roll and other virus troubles from their crops, there are many growers, particularly in our northern sections, who do not realise what they are losing each year because of the presence of these diseases.

Many garden plants, including dahlias, poppies and nasturtiums, are severely affected with virus, and these transfer so readily to cultivated food crops that it cannot be too strongly stressed that every effort should be made to clean up all sources of virus infection, not only because of the direct effect of these diseases on yield, but because of their potentialities in the development of even more serious virus disease than we have experienced in the past.

Quarantine problems.—Practically all of the diseases which affect our crops to-day are those which occur in other countries, and which now have found a suitable foothold in Australia. In the early days of settlement adequate safeguards were not available to prevent the introduction

of new diseases. In 1924 I drew attention to what were considered serious weaknesses in this respect, and suggested the formation of a group of plant specialists who would advise the Federal authorities in respect of the measures necessary to protect our crops by the formulation of measures based on the biological facts of each situation, while at the same time avoiding the danger of placing unwarranted or undue restraints on trade. A Federal director of plant quarantine was appointed in 1927 but an advisory group was called to service only this year in respect of the fireblight and citrus situations. I had discussed the menace of fireblight in the report published in 1924, and recently again at the conference of the Fruitgrowers' Federation when views expressed ten years ago were reaffirmed.

Risk of disease introduction.—In the meantime, however, many new and serious diseases have been introduced into this country, and we have incurred extraordinary risks in other directions.

Some of us may not remember that large quantities of maize have been introduced from Java and South Africa, involving the menace of establishment of the serious mildew diseases of the Orient and of possibly the worlds maize disease known—American maize smut. One report on maize from Java indicated that 200 tons were unloaded at Sydney on 6th April 1927, at 7s. 10d. a bushel, 1d. more than the rate prevailing for North Coast maize.

Our rice crops are protected only by a customs duty. There are some sixty odd diseases affecting this crop elsewhere, and some are indeed of a serious character. Our Departmental introductions are closely scrutinized, and we have intercepted and destroyed introductions affected with new diseases. The vegetable seed, and particularly the tomato seed postion is still serious. Bacterial blight of beans was unknown here prior to 1925, and several of the worst bacterial and fungous diseases of tomatoes only have been recorded during the past three or four years. Just what these diseases have meant is best known to the growers themselves, and the menace is one which has not yet been removed.

The grower's part.—In a brief survey it is not practicable to cover the subject completely but, without being an alarmist, I hope to have indicated that there is greater need than ever for farmers, fruitgrowers, and others interested in crop production to adopt measures which will reduce the incidence of disease in their crops, and, furthermore, that they will do what they can to assist this Department in its representations to ensure that more adequate protection is provided against the menace of introduction of diseases from abroad.

MIXED CROPPING IN PRIMITIVE AGRICULTURE.*

By Hugh Nicol,

(From the Empire Journal of Experimental Agriculture, Volume, III, April 1935.)

In previous publications (1, 2, 3) the author has stressed the importance to non-leguminous plants of leguminous plants growing in mixture with them. There is a considerable amount of evidence, much of which has been reviewed in (2), that in mixed cropping the leguminous component of a mixture can act as provider of nitrogen for the non-legume. The author (2) has already mentioned the practice common near Cawnpore of growing gram (Cicer arietinum) **P**[1] and wheat together. Dr. H. H. Mann recently directed[2] the author's attention to the fact that the culture of mixed crops is much more widespread than would be inferred from that isolated example.

Of bajri (Pennisetum typhoideum) in the Bombay Deccan, Mann (5) wrote:

Its real importance would be better understood if the area under the so-called bajri mixture were taken. The bajri mixture contains several leguminous crops, and hence can be grown year after year without affecting the fertility of the land to any great extent. As a result there is little of ordinary rotation practised......It (bajri) is never sown alone, but always mixed with one or more pulses and several other seeds... The special feature of the bajri mixture in this village is the very large number of (varieties of) seeds which are mixed with the bajri before sowing......The seeds sown are stated to vary according to the soil......The mixture is sown with a three-coulter drill, and at the same time a fourth row is sown either with *tur* (Cajanus indicus P) or kulthi (Dolichos biflorus **P**) according to the nature of the soil.

Mann added a table showing the proportions of seed of ten species in eight mixtures analysed after sampling at the time of sowing. No sample contained fewer than four species in addition to that sown in the fourth row.

Mann gave sociological and agricultural reasons to explain this custom of growing mixtures rather than single crops.

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* 1. Throughout the paper the less common leguminous plants are distinguished by P after their names. In quotations, P is necessarily an interpolation; in other cases the author's own interpretations are distinguished by square brackets. 2. By supplying books (4), (5) and (6), and the quotations (7), Many other references could be given.

None of the pulses, the oil-seeds, or the other constituents of the mixture are ever sown as independent crops. In practice, it is a fact that whenever the crop of *bajri* is good, the crop of pulses is poor (and so on). The land is mostly very poor, and it is hence not possible to follow a system of rotation. Hence, the mixture, which answers, in part at any rate, the same purpose, is resorted to.

It is noteworthy that the poorer the land, the smaller the proportion of bajri; one infers, without being certain, that the richer soils require a small admixture of legumes.

The question of the roles of animal manures and of leguminous plants in rotations is of considerable interest. There is evidence that one may supplement or replace the other, but as yet no experiment has been designed to test these points specifically. Since in native Indian agricultural economy, cattle and other organic manures are usually insufficient in amount, and artificials can rarely be bought, the value of the leguminous component of mixed crops emerges even more clearly than it does from a consideration of our home pastures. Voelcker (8) is definite:

It is quite a mistake to suppose that Rotation is not understood or appreciated in India. The contrary is the case. Frequently more than one crop at a time may be seen occupying the same ground, but one is very apt to forget that this is really an instance of rotation being followed ......The next year the same 'mixed crops' may be grown again, and thus to the casual observer it might appear that continuous cropping was being practised. This, however, is not so, for there is a perfect rotation of cereal and legume. (Para 304, 'Mixed Crops') In his survey of agricultural India in 1887, Wallace (9) devoted a special chapter to 'Rotations and mixed crops'. He wrote:

The growth of mixed crops is a wide-spread practice which is well worth consideration and study......The advantages under Indian conditions are distinctly great...There is but one explanation of the existence of these practices (of mixed cropping), viz., that they have been found advantageous after long experience and much careful consideration on the part of a body of workers who, for power of observation and an intelligent interest in and knowledge of everyday occurrences, would put to shame those classes which hold a corresponding position in educated Europe.

Wallace set forth, as did Mann (4,5), the reasons usually given for the benefits of mixed cropping, and stated that the roots of different species possess different root-habits and different functional powers. The case of studying root-habit in India has been forcibly put

by Howard (10) in a chapter especially devoted to 'The Economic Significance of Root-Development'. So far as the author is aware, the only study of root-interactions of crops grown singly and mixed is that made in Austria by Kaserer (11), whose valuable paper has been much neglected. Kaserer noted that there was little or no interpenetration of roots of plants of the same species grown together, however densely, whilst an increasing degree of interpenetration was noted with increasing dissimilarity of two species grown together. A legume and a non-legume showed the maximum of interpenetration: in Kaserer's words: 'Eine Graminee mit einer Leguminose zeigte stets Verfilzung.'

Kaserer's observations have an evident relation to the upkeep by one plant, of nutrients produced or made available by another. The author, with Thornton at Rothamsted, has noted the fact that the roots of lucerne, and of grass, grown together in sand-pots, are separable with difficulty, whereas no difficulty has been experienced in pating the root-systms of plants of lucerne, grass, peas, and clover, grown in single culture under similar conditions.

To Wallace might perhaps be given the credit of priority already accorded by the author (2) to Leather (12), who wondered from a consideration of the Cawnpore gram **P** and wheat mixture, whether 'the Papilionaceae are able to assist in any way the plant of another natural order *which is growing alongside them*'. Wallace wrote (9):

I am inclined, also, to think that there may be decaying roots or matters thrown off by plants of distinct species, which matters, in the hot climate, become available within the period of growth of a given mixed crop; and, in the case of a grain crop grown along with a mixture of pulse, we may have more or less of a beneficial action, such as that of the well known influence of clover root upon a succeeding wheat crop.

Wallace did not recall in this connection the British pastures, with their leguminous herbage, or the practice of sowing clover in barley. Similar omissions were made by Laws and Gilbert, Munro and Beaven, and others (Nicol (2)).

The value of having leguminous and other plants and trees in mixed culture with tea has been extensively discussed. Mann (13) has given thorough consideration to the effects, upon growth of tea, of sau (Albizzia stipulata) **P**, and several other species of trees, bushes, and crops, He wrote in 1907 (13) 'It has been suggested that possibly the tea root gets actually in contact with the root of the Albizzia tree and draws nourishment from it.' In view of Kaserer's (11) and the author's observations

upon Verfilzung, it may be hoped that more concentration will be given to the subject of the so-called 'shade' cropping in tea gardens; a study of root-habits should be particularly helpful.

The part played by leguminous 'weeds' under natural, wild, and semi-natural conditions, in maintaining and restoring the level of fertility of soils, is also striking, though it has received relatively little attention. By way of illustration of the perseverance of Nature in building up poor land, it may be remarked that upon the continuously cropped Broadbalk wheat-field at Rothamsted (in theory a pure culture) an abundant growth of wild black medick (Medicago lupulina) **P** frequently occurs on all of the cropped plots receiving no nitrogen or the lowest dressing of nitrogen.[1] The darkening of the otherwise bare stubbles by green Medicago after the 1934 harvest was sufficiently evident to be photographable by the author. Wallace (9) commented upon the richness in legumes of the natural Indian flora, and assigned to them an important part in maintaining fertility in uncropped land.

Apparently it is not essential in Indian agriculture that a mixed crop should include a legume, since the association of jowar and safflower (Carthamus tinctorius) is recorded by Mann (5), and other examples could be given. Nevertheless, leguminous plants occur in Indian mixtures with great frequency. Mollison (6) brings out this point clearly:

Various pulses, oil-seeds and fibre crops are generally grown with kharif jowar (Sorghum vulgare, a grain; kharif is the name of a season). In Gujarat there is a greater variety than elsewhere. There, subordinate to jowar, we find tur (Cajanus indicus **P**), guvar (Cyamopsis psoraloides **P**), math (Phaseolus aconitifolius **P**), mug (**P**, mungo **P**), chola (Vigna Catjang **P**), adad (Phaseolus mungo var. radiatus **P**), (all pulses), castors and til (Sesamum indicum) (oil-seeds), and ambadi (Hibiscus cannabinus) and rozi cotton (fibre plants). The group of subordinate crops referred to are not often sown all together, but mixed according to the fancy or inclination of the cultivator. In Khandesh, udid **P** (=adad) and ambadi are ordinarily sown with jowar. In the black soil of Surat, tur **P** is always subordinate to jowar, and generally along mug **P**. In the Deccan, on mixed black soil, tur P, ambadi, udid P, and sesamum, and on

1. The absence of legumes from plots receiving the higher doses of nitrogen does not imply that the nitrogenous manure was toxic to leguminous plants; it almost certainly meant that ample manuring encouraged growth of the wheat sufficiently to 'smother' the low-growing black medick. Analogous observations on clover undersown in barley were made at Woburn by Dr. H. H. Mann, who agreed with the author that the Broadbalk phenomena helped to furnish an explanation.

distinctly light soil, moth **P**, kulthi **P** and sometimes niger seed (Guizotia abyssinica) are generally subordinate to jowar.

Discussing the figures recorded for the acrage of jowar, Mollison (6) wrote:

These figures are, to some extent, misleading, because it is the general practice to sow jowari and nearly all cereals with a subordinate pulse-mixture.

The latter point is borne out in his detailed descriptions, later in the book, of the methods of cultivation of other grains.

The following is an excerpt from an article by Mollison (7), written when he was Inspector General of Agriculture in India.

The common Indian system of growing mixed crops serves in many respects the purposes of rotation. It is undoubtedly a successful and profitable method, which has done more to uphold the fertility of Indian soils than any other practice. There are very good reasons why it is profitable to grow pulses, oil-seeds, and fibre plants mixed with or subordinate to cereals like jowar, bajri, or wheat......Pulse crops whether grown alone or in combination with other crops, exercise another beneficial influence in that they enrich the soil with nitrogen, of which element Indian soils require a frequently renewed supply. The common growth of these pulses is testimony to the fundamental soundness of the traditional agricultural practice of the country. No pulse crop cultivated in India exercises such a general fertilizing effect as arhar (Cajanus indicus) **P.** Itis grown in every province mixed with other crops: its long tap-root enables it to withstand drought and to search in the subsoil for plant food: it spreads out and grows freely after the cereal to which it is subordinate has been harvested; and nearly all the leaves fall as the plants ripen, thus enriching the surface soil.

Custom varies in different districts. Thus, gram **P** and wheat or barley, a common mixture in the North-West Provinces is unknown in the Bombay Presidency (6). Mann (5), however, states that the cultivation of gram **P** in Bombay Presidency is intimately associated with that of wheat, gram having generally been considered as the natural rotation crop with wheat.

Regarding native agricultural methods in West Africa, Irvine (14) confirms the praise for mixed cropping already given by observers in India:

Mixed cropping is really a modified form of crop rotation and has several advantages......Sometimes, the two or more crops growing together use different quantities of the available plant food, and their roots go

to different depths in the soil. In this respect mixed cropping is more scientific than pure cropping.

An additional advantage claimed by Irvine for mixed cropping is the reduction of damage by insects.

Willis made several references in his book (15) to mixed cultivation and the similarity of its effects to rotation.

Mixture of crops, which seems to bring in its train some of the advantages of rotation, is very common, especially in the more equatorial parts of the tropics, such as southern Ceylon, Malaya, the West Indies, etc. Not only is there......mixture of perennial crops, but mixture of annuals is very common in the East: pulses are sown among the grain, different kinds of grain with one another, and so on. Here again the gain is somewhat like that obtained by rotation......

Of 'the wild jungle-like mixture' of trees and vegetables which forms the average native garden throughout southern Asia, Willis wrote:

As pointed out above, it is highly probable that this arrangement gives many of the advantages which have elsewhere to be attained by rotation of crops, and the villager is thus able to grow his familiar foods, etc., on the same ground for an indefinite number of years. Mixture of crops as well as rotation, requires very careful study in detail before any hasty attempt is made to change immemorial custom.

In the minds of many agriculturists, the customs of the Red Indians of North America are distinguished by their occasional practice of burying a piece of fish in each 'hill' of maize. This is often recalled as an example of primitive manuring. The author was aware of this practice but imagined that the maize was grown in pure culture, not having read or heard anything to the contrary. Consultation of the early part of Carrier's book (16) did not remove this impression, until on page 94 three quotations concerning mixed cropping were found. It is odd that Carrier has not thought it worth while to bring into relief, in his text, the practice of mixed cropping, since many other cultural operations are considered at length by him.

Hariot (17) wrote (v having been substituted for u):

All the aforesaid commodities for victuall are set or sowed sometimes in groundes a part and severally by themselves ; but for the most part together in one ground mixtly......The ground they never fatten with mucke, dounge or any other thing......

Then their setting or sowing is after this manner......First for their corne......By this meanes there is a yarde spare ground between every hold (each containing four seeds of maize) : where according to discretion

here and there, they set as many Beanes and Peaze : in divers places also among the seedes of Macocqwer, Melden and Planta Soils.

The ground being thus set according to the rate by us experimented, an English Acre containing fourtie pearches in length, and foure in breadth, doeth there yield in croppe or ofcome of corne, beanes, and peaze, at the least two hudred London bushelles: besides the Macocqwer, Melden, and Planta Solis.

Hariot also wrote of the celerity with which the ground was sown: and the abundant mixed crop yielded from ground 'having once borne corne before'. Roanoke, the part of 'Virginia' described by Hariot, is now assigned to North Carolina. Carrier (16) did not note the first paragraph here cited from Hariot.

From Pinkerton (18), after Carrier (16);

They (Indians) make heaps like mole hills each about 2½ feet from the others which they sow or plant in April with maize in each heap 5 or 6 grains, in the middle of May when the maize is the height of a finger or more they plant in each heap 3 or 4 Turkish beanes which they grow up with and against the maize.

Of Indian maize-planting in Virginia in 1606, John Smith wrote (19) :

They make a hole in the earth with a sticke, and into it they put foure graines of wheate and two of beanes.

On page 96 of his book Carrier has reproduced a picture (ascribed to Le Moyne, 1564), showing Indians planting corn and beans in the same field.

Discussion.—The foregoing review is intended to be indicative rather than exhaustive. All the authors consulted agree in assigning a prominent part to mixed cropping in primitive agriculture. No author has been found who has denied its existence. Although several sources consulted (such as the work of Fortune, Huc, King, and others on China and Japan) do not mention mixed cropping unless incidentally in relation to intensive * gardening it seems probable that in many cases the omission is due to

* A French observer, Hedde (20), under the heading 'Frucht-wechsel' wrote as follows 'Die Chinesen verstehen sich dergestalt auf die Unterhaltung der Erde durch die Kombination der veranderten Kulturen, dass man sich zu der Aeusserung veranlasst fuhlte; "Der Ackerbau ware bai ihnen Gartenbau." Sie glauben nicht daran, dass die durch die Erbaunug der ver-schiedenen Pflanzen bewirkte Arbeit die Erde jemals erschopfe in Gengentheil nehmen sie an, dass, wenn eine Pflanze einen besondern, ihr nothwendigen Stoff absorbire, sie, als eine Ausgleichung, ein neues Element oder einen naturlichen, einer audern Kultur gunstigen Dungstoff zurucklasse.'

Fortune (21) wrote of mixed crops in Chinese tea plantations: 'Another reason for the practice may be found in the fondness of the Chinese for mixing crops—a practice in operation all over the country.'

a one-sided orientation. With the Red Indians, for example, the case is clear, yet Carrier did not refer in his own text to mixed cropping as such, and omitted the first paragraph of Hariot given above. Although he claimed that the Red Indians were pioneers of intertillage for keeping down weeds, he did not mention intercropping. On the subject of rotation, Carrier wrote that the Red Indians practised a rotation of fields rather than of crops. His example shows how easy it is to miss a point. Probably the absence of specific remarks upon mixed cropping in the recorded observations of many authors is not to be taken as evidence of absence of the cultivation of mixtures.

Clover and barley, and clover in grassland, have already been referred to, as examples of mixed cropping over looked in his native land by so astute an observer as Wallace. 2

Administrators in India have recognised the fiscal importance of mixed cropping by drawing up rules for the estimation of the areas to be ascribed to each component of mixtures. It is therefore remarkable that in spite of repeated recommendations, the agricultural problems underlying the practices of mixed cropping have been so little studied. In para 60, Voelcker (8) remarked, apropos of the then recent discovery of nitrogen-fixation by legumes and their nodule bacteria :

India, to my mind, presents special advantages for the elucidation of the problem, one which, when solved, will unfold much that is still unexplained in the advantage of rotation of crops.

One of the most remarkable effects of the leguminous crop, whether in mixture or in rotation, is its apparent ability to supplement animal manures. In peninsular Indian practice (the best-studied case) it would seem that legume grown in mixture can to a large extent fill the place of animal manures. It appears unlikely that this ability is due solely to the nutrient nitrogen compounds supplied by the legumes, and it is probable that leguminous plants everywhere make a definitely biological contribution to the fertility of soil.

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2. Wallace in his chapter on 'Rotations and Mixed Crops' (8) wrote "The system is more or less known in this country (Britain), Though not extensively followed."

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Gleanings

Silage Making in Mud-walled Towers.—In the rain-fed areas of India and other places where rainfall is restricted to one season, natural green succulent fodder is available only for a part of the year. Dry, fibrous grass, or cereal crop residues, poor in feeding value and often deficient in essential minerals, are usually the only rations for live-stock through the rest of the season. All the main food and cash crops being dependent on the short and uncertain rainy season, the local cultivator is averse to growing crops merely for fodder. Green grass, however, is abundant during the rains, and at least one cutting is then possible without detriment to the subsequent hay harvest. To use this grass for pit silage is impossible, because at this time pits are full of water. Stack silage is also ruled out because of excessive drying-out in the hot season. The problem has been solved at Indore by using low circular "towers" made with mud walls such as the Indian cultivator uses for his house and other buildings. These towers have been used for three years, and enable the cultivator to preserve as silage any surplus grass, either alone or reinforced with a leguminons cover crop grown on the usual fallow before wheat.

Making the Silo.—The silo consists of a mud tower 4 feet high and 10 feet or more in diameter, with walls 2 feet thick at the base tapered to 1 foot 6 inches thick at the top. A smaller diameter leads to inefficient packing. It is built of a puddled mixture of local soil and chaffed dry grass or straw, the proportion of straw to earth varying from 4 to 8 lbs. per cubic food of earth, and depending upon the liability of the earth to shrink and crack on drying. To allow for setting not more than 1 foot height should be built in a day. When the tower is complete the wall is plastered inside and out with a fairly thick plaster of cattle dung. After not less than four days it is plastered a second time. A small outlet is provided at the bottom of the wall to prevent rain water accumulating inside when empty; this is carefully closed after the silo is charged. Such a silo lasts for several seasons with slight repairs. The gradual building of the silo can always be done by the cultivator's family during off periods and even during the rains. Usually the peasant and his wife can

prepare the mud and build one silo of this size in ninety- six hours. About 250 cubic of earth are sufficient.

Charging.—Grass just about to flower is most suitable, and edible weeds can be mixed with advantage. A mixture of coarse with fine materials, such as coarse sorghums or maize with ordinary grass or thin-stemmed edible, weeds packs better than any single material. One part of a leguminous cover crop like cowpea or beans to four parts or more of grass or cereal makes a richer silage. Chaffing is quite unnecessary. Thick and long stems of sorghums or maize require cutting into two or three shorter lengths. The material is thrown in evenly all round the silo, butts and tops alternating, and packed by trampling. Better packing is ensured by intermittent filling about a foot a day, due to natural shrinkage of the withering material. The charge is finished by stacking the material into a dome 6 inches above the wall at the periphery, and 18 inches to 2 feet at the centre.

Closing the Silo and Maintenance.—A 6- inch covering layer of chaffed straw or similar material, thoroughly wetted, is then added, followed by a foot of mixed mud and chaff thrown on top in lumps to ensure compactness. The top surface is then smoothed by hand and plastered with cattle dung. The plastering may have to be repeated several times at intervals if cracks appear. The silo can then be left alone until required. Cracks should never be allowed to remain unstopped, otherwise the silage will decay; if the silo cracks badly the whole of the contents may be spoilt. When fodder is needed the top is opened on one side and the material gradually removed.

Quantities.—One such silo holds about 4 tons of fresh material, finally yielding from 2.8 to 3.6 tons of edible silage. A portion of the material is always spoilt, the quantity depending upon the efficiency of packing conditions and tight sealing of the tower. It appears that the absolute loss of material as gas is proportional to the amount of material spoilt, and is, therefore, an indication of the extent of wasteful fermentation. No more than two such towers will be required for one pair of oxen for eight dry months when fed at 20 lbs. per animal per day. This is the rate used at Indore, and it has kept the farm stock in good condition all the year round since the inception of the Institute in 1924. (*Empire Cotton Growing Review* Vol. XI.)

Powdered Skim Milk.—Powdered skim milk, a nutritious by-product of creameries, which in the past has been kept off the retail market because of

the difficulty of marketing it in small quantities, is now available for distribution in small packages. A new type of bag container for the product has been tested by the Bureau of Dairy Industry of the Department of Agriculture and found suitable for general use. It keeps the powdered skim milk dry and eliminates the danger of spoilage. Powdered skim milk has been used, chiefly by ice-cream manufacturers, commercial bakers, and other large manufacturers of food products. Since it is a cheap means of obtaining many of the valuable nutrients in milk, the department recommends its purchase by families trying to economize on their food budgets. Food experts say that one pound of skim milk is equivalent in food value to $4\frac{3}{4}$ quarts of fresh skim milk. If the powdered skim milk is made available at food stores, at 15 cents a pound, when mixed with water it would provide fluid skim milk at three cents or less a quart, according to the department. Almost everything which is contained in whole milk, except the fat, is contained in skim milk. It has calcium, phosphorus—is high in protein and rich in vitamin G. The department nutritionists point out that dry skim milk has these same values and may be used in the same ways as fresh skim milk. Nutritionists recommend that children be given dry skim milk in their cereals, milk soups, gravies, or in cocoa made with milk powder. One warning is offered. The skim milk should be used to supplement the whole milk in the diet of children and not to take its place. One way in which powdered skim milk can be used is in baking bread. Information on this use may be obtained by writing to the Bureau of Home Economics, Department of Agriculture. (*The Scientific American*, March 1935).

Longevity of Seeds. The question of the longevity of buried seeds is always, recurring, as witness the recent revival of the fable of 'mummy wheat.' There is abundant evidence that the embryo of the wheat grain perishes relatively soon in ten years or less under ordinary conditions. Respiration goes on until the substance of the embryo is burnt away; extreme desiccation may prolong the process. Other seeds, however, do retain their vitality for much longer periods when dry, and when buried in earth germination may be indefinitely delayed. Possibly the tension of carbon dioxide in the soil gases slows down the respiration process ; again, we have found that humus particularly of deep-seated peat, contains substance inhibiting germination, even when the conditions of moisture, aeration and temperature are optimum. This raises the fundamental question of whether the life of an organism can be suspended and pass into a static condition, to be resumed when the enviroment becomes favourable again. So far as our experimental knowledge goes, seeds are always respiring,

considerably at first when they are drying off after ripening, but then more slowly, the machine Just 'ticking over' as long as life remains. If the essence of life resides in change, can there be a stop and a later resumption? On the basis of some continuing change, however minute, being necessary, how are we to account for the long dormant life of some organisms that possess a very small reserve of respirable material, as for example, the spores of bacteria which in the dry state have a very long recorded life ? Some refined experiment seems to be needed to try whether in such cases respiration however, infinitesimal, is not still going on. This is not the only unsolved question that the dormaney of seeds presents. Every farmer and gardener is familiar with the growth of certain weeds, notably charlock, which follows the ploughing up of land which may have been in grass twenty or thirty years. But why in an ordinary arable field, subject to charlock, do we get a rush of growth in one year and few or no seedlings in another? Why do other rare plants suddenly spring up in unexpected places? In Dr. Brenchley's experiments on the germination of seeds continued in soils taken at different depths from the old Rothamsted plots, the soil samples are exposed to optimum conditions of aeration, moisture and temperature, but years elapse before all the seeds germinate. In the past abnormal season many unexpected 'weeds' have appeared in the John Innes gardens. Some are comparatively uncommon plants, that as far as is known have never been grown here: for example, Datura sp., Ambrosia artemisiaefolia, Physalis edulis, etc. It may be supposed that seed had been introduced in manure but considering the rarity of the plants, that only shifts the locality of the problem. One piece of land here, after it had been cleared from sweet peas, has covered itself with Nicotiana seedlings. Nine years earlier the plot had carried Nicotiana, but in the intervening period not a seedling had been seen. We know something of the effects of 'Vernalisation' and of chilling in stimulating the germination of certain seeds which may otherwise refuse to start, but this dormancy of buried seeds still offers problems for experiment.

A cheap and efficient Rat Trap.—An effective rat trap can be made from a kerosene tin. Cut the top away, and have about 6 inches of water in the bottom. Float chaff on the surface of the water so that the rats do not see it, and on the chaff rest the bait something rather strong such as a piece of old meat. Lean a plank against the side of the tin so that the rats can climb up to the top of the tin. One drowned rat does not prevent others from jumping in. It is possible to catch quite a number

of rats in this way. *(Queensland Agricultural Journal).*

Recommendations of the Board of Agriculture.—The following are the chief recommendations of the Board of Agriculture and Animal Husbandry which met in February 1935:—(1) In every province the number of demonstration plots on cultivators' land should be increased; (2) the subordinate staff of Agricultural Departments in the districts should be strengthened particularly the staff of demonstration maistries or Kamdars or Mukkadams. (3) The staff of agricultural departments should receive special training in the methods of propaganda by the institution of short courses of instruction and that a course on publicity methods and propaganda should be included in the curriculum of agricultural colleges; (4) The propaganda relating to all the departments dealing with rural development should be co-ordinated and that Provincial Governments should entrust a special officer with this duty and also with the duty of intensifying propaganda work in the Department of Agriculture (5) Broadcasting should be introduced wherever possible for the purpose of agricultural and rural reconstruction propaganda and for giving the cultivator direct information as regards the prevailing prices of agricultural produce. (6) The Imperial Council of Agricultural Research should be asked to undertake a study of propaganda methods in India and other countries aud circulate the information from time to time to all Provinces and States concerned; (7) The Imperial Council of Agricultural Research should be asked to investigate the question of the formation of a Central Cinema Institute for making films of general and provincial interest as well as to investigate the various methods of distributing and exhibiting them in rural areas.

We recommend the extension and co-ordination of associations like the Better farming and Better living Co-operative Societies of the United Provinces and the Punjab, the Village Farmers' Associations of the Punjab, the Taluka Development Association of Bombay, and the rural reconstruction centres in many provinces for the purpose of attacking the problem of agricultural development and rural reconstruction on the widest possible front.

We emphasize the need to organise education, elementary and secondary so as to provide an agricultural bias in the former and agricultural training to a majority in the latter with a view to co-ordinate education with the needs of agriculture.

We recommend that the State should encourge agricultural graduates and educated youth with practical agricultural training to settle on cultivable waste land and conduct agriculture on improved lines and, in

order to enable them to do so on an economic basis, the State should give them such financial help as may be needed for the initial reclamation of the land and also lend on easy terms the capital required for carrying on the industry.

We recommend the preferential employment of agricultural graduates in departments of government other than agricultural such as the Revenue, Co-operative, and the Irrigation Departments as their agricultural training would make them specially effective in the discharge of their duties.

We recommend that an Expert Committee may be appointed by the Imperial Council of Agricultural Research to investigate the causes of crop deterioration caused by the continued use of home grown seed. (*The Madras Agricultural Journal).*

Water Movements in Soil-Effects of cultivation.—The value of water is impressed upon every farmer as a result of his experience. A congenial rainfall invigorates and increases his crop, whereas a period of drought may make his labours abortive. The cultivable soil is supplied with water from three sources; from the clouds, as rain or snow; from the air by absorption, as water vapour; or by condensation, as dew and from the lower layers of the soil or subsoil by capillarity or "creeping." Artificial methods are adopted where the supply of water is insufficient. Plants take up an enormous quantity of water—some one has estimated that a crop of oats uses up 400 tons—the greater part of which passes through the pores of their leaves as water vapour into the atmosphere. Evaporation is always taking places, and in hot, dry weather the surface soil becomes exhausted of water, and so shallow-rooted crops are liable to suffer. In windy weather the land dries up very rapidly, as evaporation is increased, owing to the immediate removal of the vapour from the surface of the soil by the agitation of the air. Drainage has for its object the removal of surface and surplus water, thus enabling the soil to admit air and to keep up a circulation of water in the interstices. Waterlogged soil is useless for crops; independently of drainage, providing the subsoil is porous, the water will sink or creep downwards by capillarity and gravitation. In the case of an impervious subsoil a water table is formed, and the depth at which it occurs is a very important matter for the farmer to ascertain. If near the surface a water table is a source of trouble, as its presence leads to the decline of deep-rooted plants, and, more over, the loss of water by evaporation may, at a critical time, completely exhaust the supply. Nature ordains that the soil will store up water during the winter for the use of plants in the spring. Modern

cultivation, having for its object the growth of heavy crops, including grass, necessarily entails some provision for the retention of water in the soil. Particles of rocks, earthly materials, and organic or vegetable substances, of which the soil is chiefly composed, are all concerned in the distribution of water. The vegetable fragments absorb large quantities of water, while the rocky and earthy particles retain it by clinging or surface tension. Each particle becomes wrapped, as it were, in a clock of water of varying thickness. The thickness of the clock depends upon the water supply, and when a very low limit has been reached the covering gradually disappears owing to capillarity absorption by rootlets and evaporation. A certain quantity of water, however, always surrounds the small fragments in the soil, and when the minimum is reached plants can no longer by their use make use of it, their power of absorption being weaker than the surface tension or clinging force of the particles. Suppose a farmer takes a big clod in his hand and breaks it up into a dozen smaller ones, he can readily see that the latter will require a much larger amount of water to cover their surfaces than the original mass. Hence, it is obvious that one means of conserving water in the soil is through cultivation by which a fine tilth is produced. If one has the draught power, summer cultivation is always the best, especially on clay lands. As already stated, the soil stores up water during winter. If ploughing is postponed, until the early spring the soil not only contains less water, but the water lost during the operation is considerable. Evaporation takes place at considerable depths in the soil, depending largely on the air present, and as the surface temperature in spring is less than that below, the vapour as it rises is condensed, and so a moist surface is the result. In summer the reverse is the case, the surface temperature is the greater, and a dry condition is produced. Too much vegetable matter, as in peat soils, is objectionable, and so are too fine particles; but if a soil is not naturally clayey, no amount of cultivation will render it so. A good soil is, in reality, a composite; it needs to have enough clay and humus to hold water, and to draw the water to the surface for plant roots when overground drought conditions require it; enough humus and clay to provide food for plants, and enough sand to make it porous, warm, and easily worked. ("*The New Zealand Farmer.*")

Iodised Wraps for Fruit Storage.—Mr. R. G. Tomkins, of the Low Temperature Research Station, Cambridge, has investigated the possibilities of using iodised coverings for fruit when placed in storage. The severity of many fungal diseases of storage is notorious, and the use of

germicidal covers would appear to be one of the most obvious methods of control, if the fungicide has no harmful effect on the fruit. Initial difficulties seem to have been largely overcome (J. Pomol and Hort. Sci., 12, No. 4 pp. 311-320, December 1934). The iodised wraps are made by treating tissue paper with a definite volume of iodine solution—a covering 25 cm. square contains approximately 30 mgm. of free iodine. Laboratory tests show that storage rots of fruit can be considerably reduced by this kind of wrapping, whilst the appearance and ripening of most varieties is not impaired. Problems for the future include a study of the amounts of iodine absorbed by the fruit and a more extensive determination of varieties which are harmed by iodine treatment. (*Nature* Vol. CXXXV, No. 3404, p. 154-1935.)

Horse and Tractor Cultivation Compared.—The different kinds of implements used in soil cultivation have all developed from a pointed stick whose function was to stir and break up the soil. Cultivators and horrows are in the direct line of descent from the pointed stick: the plough represents a divergence from the line, in that its purpose is to invert the soil rather than to stir it. The extremes of plough design are the sod or grassland plough which turns over an almost unbroken ribbon of soil, and the digger-breasted plough common in continental areas, which turns over a rough broken furrow with the maximum of disruption and mixing. Before the advent of the tractor, the design of cultivation implements and their methods of use had evolved subject to two basic considerations: a supply of cheap and abundant labour, and a forward speed of 2½ m. p. h. which suited the natural walk of both horse and man. At first the tractor had little effect on these considerations—It was regarded as a more powerful haulage agent than horses, and, therefore, suitable for heavy jobs, such as stubble-breaking and deep ploughing. With further experience, and with the better designs of the tools for the lighter forms of cultivation, the scope of the tractor rapidly increased. The addition of such improvements as the power take-off and the development of power-operated implements for the hay crop opened up additional uses for the tractor as a farm tool. There is little doubt that a steady increase has taken place in the number of hours' work per year put in by the tractor on the average farm. Periodical censuses carried out by the Agricultural Economics Research Institute, Oxford, on farms employing both tractors and horses show that the hours of work of the tractor per year on all jobs are about half those put in by the horse. There is undoubtedly room for this figure to be appreciably increased, the general introduction of rubber tyres may help here. But, desirable in many ways

though this increase may be, it must be remembered that the outstanding advantage of the tractor is its ability to deal quickly with urgent work. Farming cannot be done to a rigid time-table; the weather is the controlling factor. In unfavourable seasons the farmer may be unable to work his soil when he wishes. He must produce a suitable tilth before he sows, and for this he may be compelled to wait so long that his crop, when sown at last, is almost certain to suffer in yield. It is in such conditions, and in the preparation of land for the next crop, immediately after the current one is harvested, that the tractor finds a most useful avenue of employment. Similarly, in preparing the soil for spring-sown crops, the inevitable rush of work in the few fine spells in a wet spring can be tackled with some hope of success. The economic value of this reserve of power, especially to the farmer on heavy land, is incontrovertible. The tractor enables him to cut costs directly, but even more important is the indirect cost-cutting, through the ability to get work completed in unfavourable spells. No costings system can show the money value of indirect savings, for obvious reasons but no farmers would dispute their importance. Agricultural economists have made numerous comparisons of tractor and horse costings on the farm. In common with all agricultural costing data, they present difficulties which do not arise in other industries. Take as a simple example the cost of keeping a horse. It will be fed, wholly or partly, on food grown on the farm. What figure should be assigned to this food " It should be less than the market price of the foodstuff, but to what extent" If it is not even possible to state the exact cost incurred by the farmer in growing his food, since the yield is controlled, to a degree not precisely known, by the residual value of the manures applied to the preceeding crops. Some conventions must therefore be adopted, on which agricultural economists have not yet arrived at complete agreement. But, in spite of these inherent difficulties, direct comparisons of horse and tractor costings are capable of showing in what way the tractor can achieve a direct saving as compared with horse-power. Some typical results are given in the following table, which has been constructed from figures supplied by agricultural economists. The figures, which are some years old, apply to individual farms employing both horses and tractors, and this partly accounts for the wide variations in costs for the same work. For our present purpose, however, this does not matter :—

Cost per Acre for Horse and Tractor—Wages Included.

Ploughing :

Horse, 20s., 19s., 10d., 14s., 10d., 17. 2d.

Tractor, 15s. 9d., 14s. 6d., 11s. 11d., 8s.

Cultivating :

Horse, 2s. 6d., 4s.

Tractor, 3s. 6d., 4s. 5d.

Harrowing :

Horse, 1s. 6d.

Tractor, 2s. 1d.

Rolling :

Horse, 1s. 6d.

Tractor, 2s. 1d.

Harvest :

Horse, 2s. 7d., 2s. 8d , 2s. 1d,

Tractor, 3s. 11., 3s. 6d., 4s. $7\frac{1}{4}$d.

The salient feature of the table is that on all these farms tractor ploughing is cheaper than horse ploughing, while in all the other operations the reverse is the case. The explanation is simply that in ploughing the tractor is given a full load, while in the other operations it is working below its capacity. The practical implication is, therefore, that all tractor cultivation tools should be designed to give a full load like the plough. The modern tractor cultivator already does this, but there is still scope for the farmer to use gangs of harrows to increase the resitance for this naturally light type of cultivation. The above results have an important bearing on the question of complete mechanisation of arable farming. Here it should presumably be easier to design the equipment and to operate it so that a full load is always given, although in most parts of the country extensive and perhaps costly alterations in the field boundaries would be needed.—*From a paper on "Functions of Mechanical Power in Soil Cultivation" read at the Institution of Automobile Engineers by Dr. B. A. Keen, Asst. Director, Rothamsted Experimental Station.*

Current Research

A new method using Alkaline Permanganate for Oxidation of Organic matter. J. N. Chakraborty, (*Indian Journal of Agricultural Science*, Vol. V Page 41, 1935). A new method for the mechanical analysis of lateritic soils has been developed using alkaline permanganate to remove organic matter. The results for clay and clay plus silt obtained by this method in the case of 18 lateritic soils from all over India were comparable to those obtained by International Soda method. The loss on solution in this method is not greater than that in the International Soda method. Shaking for six

hours in a rotary shaker is sufficient for complete dispersion of soil by this method. This method without modification was able to disperse completely four lateritic soils in which large quantities of calcium carbonate and sulphate have been added. The method is described fully. Advantages of the method are:—(i) Alkaline permanganate is equally suitable in temperate and tropical countries where hydrogen peroxide is less stable (ii) It can be used in manganiferous soils where hydrogen peroxide is required in large quantities or is useless. (iii) Time required for oxidation does not exceed three hours even in soils containing large quantities of organic matter (e. g. 10 per cent.) On the other hand hydrogen peroxide and sodium hypobromite require much longer time for the purpose. (iv) Obnoxious and injurious chemicals like bromine, as in the method using sodium hypobromite, are avoided. (v) This reagent is much cheaper than either hydrogen peroxide or sodium hypobromite. Although the alkaline permanganate method has been shown here to be quite suitable for the mechanical analysis of Indian lateritic soil, it is expected that the method will prove equally suitable for all other types of soil.

Stinking smut (Bunt) of wheat with special reference to Tilletia Indica Mitra.—By M. Mitra: (*Indian Journal of Agricultural Science*, Vol. V, Page 51. 1935). Bunt on wheat in India is caused by three species of Tilletia, that is, *T. Caries*, *T. Foetens* and *T. Indica* and is confined to the north western parts of India and does a fair amount of damage. *T. Caries* and *T. Foetens* are restricted to the cooler regions while *T. Indica* is confined to the plains. All the three species possess a stinking smell. *T. Indica* can very easily be distinguished from other species by its partial attack on the grain and also by its black coloured spore mass, while in the other two species the whole grain except the seed-coat is destroyed and the spores are dusty olive brown or rust coloured in mass. Spores of *T. Indica* are much larger than those of *T. Carries* to which it is closely allied and it appears that there are at least two physiologic forms of *T. Indica*. The biometric analysis of data of spore measurement shows that this method can be employed to determine physiologic forms though it is not enough to identify the different species. There is little possibility of any wind dissemination of spores directly from the bunted head as occurs in the case of *Ustilago tritici* (Pers.) Jens. The bunted grain is wholly or partly concealed by the glumes and before the harvest there is little or no opportunity for the dissemination of the bunted spores. When the crop is mature, the bunted grain is sometimes easily displaced and falls on the ground with a slight disturbance and thus infects the soil. The danger of dissemination of bunt spores lies in the threshing operation

when they adhere to the surface of the sound grain and lodge in the brushes. Large number of grains thus get infected. When the bunted grains come in contact with the healthy ones in storage, they infect the latter very easily. It has also been shown by a series of infection experiments done at Karnal and Pusa that infection does not take place in Pusa whereas at Karnal the disease appears almost every year. It is due to different climatic conditions. Control measures tried show that the percentage of infection can be reduced by treatment with fungicides like uspulun (universal), copper carbonate ceresan and formalin but none of them is able to check the disease altogether, the reason being that spores are well portected in mildly attacked grain by the pericarp and the fungicide cannot reach the spores. It is supposed that hot water treatment may be a possible method to check the disease to a greater extent, and as loose smut is also very common on wheat, one treatment might do for both the diseases. Further, there is an indication that as in other bunts infection can take place from infected soil and so rotation of crops is advisable. It would be better if from time to time Karnal seed is renewed with seed from Pusa which is free from both bunt and smut.

The relation of some plant characters to yield in sorghum By G. N. R. Ayyangar and others: (*Indian Journal of Agricultural Science* Vol. V. Page 75, 1935). The correlation between grain yield per plant and eight other plant characters have been determined in two irrigated and three rain-fed Coimbatore varieties of sorghum. The diameter of peduncle, weight, length and thickness of earhead and straw weight have given high positive correlation values. These characters can be used as reliable indices in selecting for yield. The weight of 100 grains has given high correlation values in the irrigated varieties while in the three dry varieties it was low. The length of peduncle is either not correlated or is negatively correlated with yield. In the two irrigated varieties studied the duration was found to be negatively correlated with yield. Partial and multiple correlations were also calculated. The total grain yield of a plant can be predicted very closely, when the diameter of peduncle, length and thickness of earhead, and the weight of 100 grains are all known.

Comparative trials of Calcium Cyanamide aud other Nitrogenous fertilizers on arable crops. E. M. Crowther: (*The Empire Journal of Experimental Agriculture*, Vol. III Page 129, 1935). In a series of 22 field trials at Rothamsted and other centres on spring crops-barley, potatoes, and sugar-beet—calcium cyanamide and ammonium sulphate gave similar yield increases in 11 of the 15 experiments in which there were significant responses to added nitrogen, and calcium cyanamide was less efficient

than ammonium sulphate in the other four. In five experiments at Rothamsted on winter cereals there was no clear difference between autumn and spring dressings of nitrogenous fertilizers or between calcium cyanamide and ammonium sulphate, except with repeated small applications during winter and spring, when calcium cyanamide was worse than sulphate of ammonia. Autumn dressings of dicyanodiamide, either alone or mixed with calcium cyanamide, gave good results on winter wheat.

Breeding for milk production in the tropics.—J. Edwards *(Journal of Dairy Research,* Vol. III, No. 2, May 1932). One of the most fundamental problems of tropical dairying consists in the establishment of breeds of dairy cattle which will live and thrive in their environment. How this problem is dealt with in Jamaica is shown by the author by an analysis of the data of milk records and pedigrees of the dairy herd at the Government Stock Farm at Hope, Kingston, Jamaica. At this farm numerous crossing experiments have been tried with native cattle and imported European and Indian breeds, and the paper deals with the analysis of the detailed records kept of these experiments. The analysis is divided into two parts : (a) the analysis of the bull's progeny (b) analysis of yield on percentage of Indian blood basis. An analysis of the 'failures' has also been made. And the conclusions are summarised as follows. (1) The European group (with no Zebu blood) is seen to possess a low average yield and a high percentage of constitutional failures. Its representatives have the inheritance to produce milk but lack the constitution to express their inheritance. The group of grades with one-half Zebu blood has a similar average yield and an equally high percentage of non-producers which might be in this case termed temperamental failure. The group possesses constitution but lacks the factors for a better milk inheritance and docility. (2) The occurrence of the highest average yields amongst the grades possessing one-thirty-second to one-quarter Zebu blood coupled with a lower percentage of failures in these grades, points to their being the most satisfactory medium for the development of a new breed suited to environment. The author prefaces his analysis with a review of the results of cross-breeding experiments in other tropical and sub-tropical regions of the world, including India, and the review makes interesting and valuable reading. The common feature of the experiments is that the importation of Europen breeds into the tropics is usually a failure and not satisfactory as a general breeding policy. The first generation from imported animals may be satisfactory but subsequent generations are

usually unable to maintain the constitution necessary to thrive satisfactorily in a tropical environment. He, therefore, draws the conclusion that for tropical countries like India the solution of the problem of providing satisfactory milch cattle for ordinary conditions of feeding and management lies in the improvement of indigenous stock. It is true that the indigenous cattle of India are usually of heterogenous origin and their improvement is likely to be somewhat protracted but the building up of a strain of improved stock always takes time. e. g., the Europen breeds have taken two centuries to attain their present level of production. Indian cows however possess the constitution to thrive in their environment, and experience in Texas, Kenya, Trinidad, and North Africa tends to show that it is essential that a certain proportion of Zebu blood should be maintained if disease resistance and milking propensities are to be combined in one animal in a tropical environment (*Agriculture and Live Stock in India*)

Anthesis and Pollination in Bengal Gram (*Cicer Arietinum*) By V. R. Ayyar and R. Balasubrahmanyan, (*Madras Agricultural Journal*, Vol. XXIII Page 170. 1935). Observation made at comibatore on the time of opening and closing of flowers in Bengal gram (*Cicer Arietinum*) disclosed that—(a) Cleistogamy was present and its proportion seemed to be altered by difference in nutritional conditions in the soil. (b) All the flowers that opened on the first day did not open on the second day. (c) The time of active blooming was between 9 and 10 A. M. on the first day. In a summer crop, most of the flowers opened at 2 P. M. (d) The march of cloing was more gradual and less rapid than that of opening. (e) The petals opened and closed much earlier on the second day of their opening. (f) The total period during which a flower remained open was less on the second day of opening and during hot months. It was also found that the anther dehiscence and poilination occurred one day before the opening of the flowers, and there was hardly any cross pollination notwithstanding the fact that the pollen grains were viable at the time of flower opening. The method of crossing that has been found successful is described

A study of Phosphorus Penteration and availability in soils. L. A. Brown: (*Soil Science* Volume 39, Page 277). Amounts of available phosphorus at 15 depths in the upper foot of permanent pasture plots were determined by the Truog method. The data show that biennial surface applications of superphosphate penetrate not more than 2 or 3 inches perhaps much less in 16 years. Rock phosphate applied in the same manner penetrated more than 7 inches. Eight years after the last application of rock phosphate and three years after the last superphos-

phate application the rock phosphate pasture contained 188 pounds per acre of available phosphorus ; and the superphosphate plot, 18 pounds per acre. Rock phosphate application contained four times as much phosphorus as did superphosphate application. Laboratory percolation studies show that more phosphorus is available in rock phosphate treated soils of wide range of pH and treated with various nitrogen carriers than in the same soils treated with superphosphate. Rock phosphate penetrated more rapidly than superphosphate in an acid soil, but the reverse was true in alkaline soils. Ammonium sulphate or soidum nitrate speeded the penetration of rock phosphate more than that of superphosphate, especially in an acid soil. The field and laboratory penetration studies all show more soluble phosphorus in rock phosphate treated soils than in superphosphate treated soils. In most field tests in which a comparison has been made of superphosphate and rock phosphate, however, superphosphate has proved the better phosphorus fertilizer.

Biochemistry of water-logged soils. Part IV. Carbon and nitrogen transformations. A. Sreenivasan and V. Subrahmanyan :

Journal of Agricultural Science. Volume 25, Page 6. During the fermentation of water-logged soil containing added substances with different carbon-nitrogen ratios, the reaction first turns slightly acid, but soon returns to the original hydrogen-ion concentration (H 7. 6). The quantities of ammonia present in the medium increase up to a point, after which there is steady decrease. There is nitrification only in the case of substances with narrow C/N ratios. The production of nitrate generally commences only after about a month, when the vigour of the initial fermentation has subsided and fairly large quantities of ammonia have accumulated in the medium. The extent of mineralisation of nitrogen is determined chiefly by the C/N ratio, though in the cases of substance like *mahua* and *lantana* the presence of other constituents may also influence the process. The quantities of mineralised nitrogen present in the soil system generally tend to decrease after about two months. Carbon is lost from all the added materials, especially those with wide C/N ratios. Substances with narrow C/N ratios lose more nitrogen than the others. There is practically no formation of complex nitrogenous bodies from substances with narrow C/N ratios, the major part of the added nitrogen being either mineralised or otherwise lost from the soil system. Such substances will therefore have no residual value. On the other hand, materials with wide ratios mineralise very slowly; they are mostly present as complex forms, so that although they possess very little immediate fertilising value their residual effect in the soil may yet be high. The loss

of total nitrogen observed, especially with urea and dried blood, is largely accounted for by volatilisation as ammonia from the soil system. Under the swamp soil conditions ammonification proceeds at a very much faster rate than nitrification so that there is accumulation of ammonia in the medium. The volatilisation of ammonia is favoured by the high temperature prevalent under tropical conditions. A similar, though less heavy, loss was also observed under dry soil conditions, accounting for over 60 per cent, of the total nitrogen lost from the soil system.

An analysis of the time change in milk production in individual lactations.— By M. Gooch, (*Indian Journal of Agricultural Science,*) Vol. 25, Page 71. This study treats of the progress in the milk production of a cow during a single lactation, and the relation of this trend to various factors associated with the particular lactation. The analysis is based on the monthly milk production records of all cows having six or more lactations, in a single large herd of pure-bred Jerseys. The herd provided records on ninety-nine such cows having a total of 679 lactations. Since the trend in the amount of milk produced in a lactation may be described by a simple exponential curve, this equation was fitted to the first 8-months' production records for each of the 679 lactations. From these curves, constants were obtained which measure for each lactation: the theoretical initial yield; the decline of milk yield with time, or in other words the persistency rate; and the scatter of the observed monthly yields about the smooth curve. It is these constants which were studied relative to certain general and biological factors. Distributions of these three constants are not far from normal and their association is studied by means of the correlation co-efficient. There is a fair-sized negative correlation between the persistency factor and initial yield, that is more persistent milkers tend to start their lactations relatively low. There is no correlation between scatter of the observed monthly yields about the fitted line and either persistency or initial yield. The trend of the 8-months' total yield, during the years covered by this study, indicates that there has been some selection of cows for a high yield. This may have been brought about by selecting cows with comparatively high initial yield, since such cows have a high 8 months' total. There has been no apparent selection for persistency, and the variability of the observed yields about the smooth curve increases during the time period studied. Total yield shows a slight negative correlation with both persistency and variability of the monthly yields. Theoretical initial yield is quite closely correlated with the production during the early part of the lactation, so that it seems fair to say that the amount of milk

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a cow gives soon after calving will be a fair index of her potential worth. The trend of milk production during a lactation is related to the season in which the lactation starts. The more persistant milkers begin in the winter months, while the cows with higher than average initial yield start their lactation in the early spring. The deviations of monthly yield from the smooth curve show no seasonal variation. The age of the cow is associated with the trend of the milk production, in that the younger cows are more persistent and the older cows start their lactations at a higher level and deviate somewhat more widely from the fitted curve. In this sample with records that cannot get closer than one month to parturition, the length of gestation shows no effect on the trend. The length of the resting period and length of time milked show a relation to all three constants describing the trend of milk production. A resting period before a given lactation of more than eight weeks is associated with an increased initial yield, a decreased persistency, apparently due to the selection for early breeding of persistent cows, and somewhat larger deviations of the monthly yields from the smooth trend. The cows which were milked for a longer time than the average are more persistent, start their production at a relatively low level, and tend to be less variable. The analysis of variation in trend of milk production from one lactation to another shows that there is a greater variation between lactations of the same cow than between cows, in both initial yield and persistency. This result holds not only for total variations but for the variation remaining after variability due to age has been eliminated. Age differences increase the variation in presistency very little but have more effect on variation in initial yield. From this study two main facts stand out: first that the amount of milk that a cow gives at the beginning of her lactation is an important figure diagnostic of her ultimate worth as measured by total yield; and second, that breeding for high-producing cows will not reduce the variability with a herd to a low level unless the individual cows have a greater uniformity than they show in this herd, with regard to the trend of their individual lactations.

Crop Forecasts.

SUGARCANE.

Final General memorandum on the Sugarcane crop of 1934-35.

All India.—This memorandum is based on reports received from provinces and States which contain, on an average, a little over 86 per cent of the total area under sugarcane in India. The area sown is estimated at 3,471,000 acres, as against 3,308,000 acres last year, or an

increase of 5 per cent. The total estimated yield of raw sugar (*gur*) now stands at 5,085,000 tons, showing an increase of 4 per cent over the last year's yield of 4, 872, 000 tons. Prospects of a very good crop have been marred by a severe cold spell and frost that occurred during the latter part of January. Complete information regarding the damage done to the crop is not yet available, but from the reports so far received it appears that the estimate of yield given above is likely to be reduced considerably.

United Provinces (51.7 per cent)—The area planted is estimated at 1,839,000 acres (26,000 acres being in the Rampur State), as against 1,734,000 acres last year. The estimated yield of raw sugar (*gur*), as calculated on the new basis adopted this year, stands at 2,758,000 tons (39,000 tons being in the Rampur State), as compared with 2,570,000 tons last year, or an increase of 7 per cent. Of the total area in the British districts, 1,560,000 acres are reported to have been planted with improved varieties of cane during the current year which are estimated to yield about 2,452,000 tons of gur.

Punjab (14.7 per cent).—The area is finally reported to be 462,000 acres, showing a decrease of about one per cent as compared with last year. The total outturn is estimated at 316,00) tons, or 13 per cent less than that of last year.

Bihar and Orissa (9.7 per cent).—The area planted is estimated at 445,000 acres, as against 418,000 acres last year. The increase in area is attributd partly to favourable weather conditions and partly to the opening of sugar factories in north and south Bihar. The total outturn is estimated at 673,000 tons, as compared with 623,000 tons last year.

Central Provinces and Berar (0.8 per cent).—The area planted is estimated at 28,000 acres as against 29,000 acres last year. The yield is estimated at 46,000 tons, as compared with 48,000 tons last year. The season was, on the whole, favourable although the crop suffered slightly from excessive early rain in three districts. For the province as a whole, the yield is estimated at 108 per cent of the normal.

Sugar in Foreign Countries.—From the latest information received from the Sugar Technologist to the Imperial Council of Agricultural Research, India, Cawnpore, it appears that the *world's production* of sugar, both cane and beet, during 1933-44 is estimated by Messrs. Willett and Gray at 25,443,000 tons (16,716,000 tons of cane and 8,727,000 tons of beet sugar), showing an inc rease of 1,353,000 tons (261,000 tons in the case of cane sugar and 1,092,000 tons in the case of best sugar) as compared with the preceding season. *(The Indian Trade Journal.)*

RICE.

Final General Memorandum of the Rice Crop of 1934-35.

All India.—The memorandum is based on reports received from provinces and States which comprise 97 per cent of the total rice area in India. The statistics of acreage, outturn, etc., refer to both early and late crops in all the reporting provinces and States. The total area reported is 81,026,000 acres, as compared with 83,102,000 acres in the previous year. The total yield is estimated at 29,830,000 tons of cleaned rice, as against 30,863,000 tons in 1933-34. The decrease is 2 per cent in area and 3 per cent in yield. The condition of the crop is, on the whole, reported to be fairly good. The average yield per acre works out at 825 lbs. as against 832 lbs. in 1933-34, 841 lbs. in 1932-33, 876 lbs. in 1931-32 and 871 lbs. in 1930-31.

Central Provinces and Berar (7.6 per cent).—As reported in December forecast, the area is estimated at 6, 782,000 acres (1,130,000 acres being in eleven Feudatory States), as compared with 6, 881, 000 acres last year. The yield is estimated at 2,081,000 tons (296,000 tons being in the Feudatory States), as against 1,987,000 tons last year. The average outturn for the province as a whole is, as reported in December last, 107 per cent of the normal, as against a full normal yield last year.

Rice Crop in Foriegn Countries.—From information specially obtained, it appears that the estimates of the rice crop of Formosa for 1934 place the area and yield at 1,648,000 acres and 45,637,000 bushels (or 1,290,000 tons), showing a decrease of 1 per cent in area but an increase of 10 per cent in yield as compared with 1933. In Siam, the total production of paddy was estimated at the end of November, 1934, at 86,400,000 piculs (or 5,143,000 tons). The exportable surplus is placed at 42,280,000 picules of paddy (or 2,517,000 tons), which is equivalent to 31,710,000 picules (or 1,887,000 tons) of rice and rice products. The estimate of the rice crop of Japan for 1934 is placed at 50,746,000 koku (or 7,117,000 tons) as compared with 70,847,000 koku (or 9,936,000 tons) last year.

From the latest available bulletin published by the International institute of Agriculture, Rome, it appears that the estimates of the 1934 crop of the United States of America are 781,000 acres and 769,000 tons of rough rice, showing a dicrease of 1 per cent in area but an increase of 3 per cent in yield as compared with 1933. In Italy, the area and yield of rough rice are 323,000 acres and 607,000 tons, as against 316,000 acres and 598,000 tons in 1933. In Egypt, the area under rice in 1934-35 is estimated at 396,000 acres with a yield of 500,000 tons of rough rice, as compared

with 438,000 acres and 526,000 tons in the previous year. In Cochin-China, early varieties are reported to be satisfactory and generally above the average in the east. Floods have caused damage on low lands, while lack of water has affected the crop on high lands. Some damage was caused by fleas but this was checked by rains. *(The Indian Trade Journal.)*

WHEAT.

Fourth Wheat Forecast 1934-35.

All India.—This forecast is based on reports received from provinces and States which comprise a little over 28 per cent of the total wheat acreage of India. The returns, therefore, cover practically all the important wheat—growing areas in India. The final memorandum on the wheat crop will be published, as usual, in the second week of August. The total area is now returned at 34,478,000 acres, as compared with 35,799,000 acres (revised) at this time last year, or a decrease of 4 per cent. The total yield is now estimated at 9,823,000 tons, as against 9,431,000 tons (revised) at this time last year, or an increase of 4 per cent. The crop was adversely affected in places by cold, frost, hailstorm, rust, etc., but its present condition is, on the whole, fairly good.

Central Provinces and Berar. (10. 1 per cent)—The area is estimated at 3,699,000 acres (84,000 acres being in the Indian States), as against 3,541, 000 acres, the revised area of last year. The yield is estimated at 792,000 tons, (17,000 tons being in the Indian States), as compared with 735,000 tons, the revised yield of last year. During April, the weather was warm and occasionally cloudy. Light to moderate showers of rain, accompanied by high winds and light hail in certain localities, fell all over the province in the first and third weeks of the month. Thereafter the weather has been generally clear and hot.

Wheat in Foreign Countries.—From information specially obtained, it appears that the area sown with winter wheat for the 1935 crop in the United States of America is estimated at 44,336,000 acres : and the production is estimated on the basis of the condition of the crop on May 1 at 431,637,000 bushels (or 11,562,000 tons), as compared with 461,471,000 bushels (or 12,361,000 tons) estimated at the corresponding time of last year. The area sown with winter wheat for the 1935

crop in Canada is estimated at 663,000 acres, which is 5 per cent below that of the preceding season. In Australia, the estimates for the 1934-35 wheat crop are 12, 965,000 acres and 135 million bushels (or 3.6 million tons), showing a decrease of 14 and 23 per cent, respectively, as compared with the preceding year. The yield of the Argentine wheat crop of 1934-35 is estimated at 6,382,000 tons, as compared with 7,662,000 tons in the preceding year. The production of the 1934 wheat crop in the U. S. S. R. is estimated at 29,921,000 tons, as compared with 27,292.000 tons in the preceding year. (*The Indian Trade Journal.*)

OIL-SEEDS.

Final General Memorandum on the winter Oilseeds (Rape, Mustard, and Linseed) Crops of 1934-35.

All India.—This forecast is based on reports received from provinces and States where rape seed, mustard and linseed are grown to any considerable extent. These provinces and States comprise about 96 per cent of the total area in India under rape and mustard and about 94 per cent of the total area under linseed in India. As stated in the preceding forecast, the crops were damaged by cold and frost, though linseed fared better than rape and mustard. The condition of the crop is, on the whole, reported to be fair.

Rape and Mustard.—The total area under rape and mustard amounts to 5,316,000 acres, as compared with 6,034,000 acres last year. The total estimated yield is 895,000 tons, as against 943,000 tons last year, or a decrease of 5 per cent.

Linseed.—The total area under linseed is returned at 3,381,000 acres, as against 3,261,000 acres last year. The total yield is estimated at 418,000 tons, as against 376,000 tons last year or an increase of 11 per cent.

Central Provinces and Berar.—(27.8 per cent)—The area sown is estimated at 1,107,000 acres (including 128,000 acres for Indian States), as compared with 1,061,000 acres last year. The yield is estimated at 97,000 tons (10,000 tons being in the Indian States), as against 90,000 tons last year. The weather during April was warm and occasionally cloudy. Light to moderate showers of rain accompanied by high winds and light hail in places fell all over the province in the first and third weeks of the month. Subsequently the weather has been generally clear and hot. Cloudy weather and absence of winter showers in December and frost and severe cold wave and hail in january and February last affected the crop to some extent. For the province as a whole, the outturn works out at 92.2 per cent of the normal, as against 91 per cent last year.

Oil-seeds in Foreign Countries.—Form the latest available bulletin published by the International Institute of Agriculture, Rome, supplemented by information specially obtained by cable, it appears that the area and yield of linseed in the United States of America for 1934 are 974,000 acres and 5,253,000 bushels (or 131,000 tons),as against 1,328,000 acres and 6,947,000 bushels (or 174,000 tons) in 1933. According to a report on planting intentions as at March 1,1935, published by the Department of Agriculture, the area intended to be sown to linseed this year in the United States of America is 1,845,000 acres, or an increase of 23 per cent over the area sown last year. The estimates for the Canadian linseed crop of 1934 are 227,000 acres and 910,000 bushels (or 23,000 tons), as compared with 244,000 acres and 632,000 bushels (or 16,000 tons) in the preceding year. In the Argentine, the area under linseed during 1934-35 is estimated at 6,919,000 acres, as against 4,878,000 acres in 1933-34. The production of the crop is estimated at 1,927,000 tons, as compared with 1,417,000 tons in the preceding year. (*The Indian Trade Journal.*)

College News

Social Gathering.—The annual social gathering of the College was celebrated on the 14th and 15th of December. The celebration started on the morning of the 14th with the reception of old boys and members of the staff in the College Hostel. This pleasant function was attended by most of the old boys in station. Many of the olds boys present enlightened us by short but interesting speeches about the activities and social functions of the College during their times and this pleasant function was then brought to a close by proposing a toast to all the old boys present by the general secretary.

The noon was occupied by a cricket match between old boys and members of the staff and present students, where we had the rare chance of witnessing the experienced old hands sending balls boundary after boundary. Our Principal and Mrs. McDougall were also present to witness the batting of Messrs. B. R. Phatak, D. V. Bal and others from the staff side.

The evening of the day was taken up by the photograph and the tennis matches.

In the night there was a variety entertainment and fancy dress competition; the principal items were vocal music presentation of a few scenes from Shakespeare's Merchant of Venice and a comic scene from a Marathi play. Mr. H. Das of the first year deserves special congratula-

tions for his performance in vocal music. The night's function was very interesting and the two dramatic performances were also very successful. Our thanks are due to Messrs. V. G. Rao and N. V. Bapat for their able management. The function was well attended and we had many distinguished guests amongst us that evening.

The next day's function opened with sports. The noon was occupied by the finals of indoor games and the elocution competition.

The Address and Prize Distribution ceremony was presided over by the Hon'ble Mr. B. G. Khaparde, Minister for Education. The function was attended by the students and staff of the College and some of the leading citizens of Nagpur interested in agriculture and the Agricultural College. The principal opened the proceedings with a short speech in which he introduced the president to us and also referred to some of the lines of advance our College has made during the last two years giving special reference to the B. Ag's being permitted to go up for law and other advanced studies.

The general secretary then read a short account of the social activities during the year. He also dealt with the necessity of certain important reforms concerning the hostel and its neighbourhood. This was followed by the distribution of prizes and medals by the president.

In a short and effective address the president referred to some of the points raised by the general secretary, and exhorted the students to develop the spirit of true sportsmanship.

The President and the guests were then garlanded and the party moved on to the grounds of the Research Institute where Mr. and Mrs- McDougall were At Home to the guests.

COLLEGE PRIZE WINNERS.

4th year.

1.	The Smythies Chemical Medal	D. Misra.
2.	The Napier Essay Prize.	P. V. Bhagwat.
3.	The Kedarnath Rai Prize for Engineering.	K. B. Rahurkar.
4.	Special Prize in Agriculture.	D. Misra.
5.	Special Prize in Entomology.	Zafar Ali Khan.
6.	Special Prize in Botany.	Zafar Ali Khan.
7.	Special Prize in Veterinary.	N. P. Konher.

3rd year.

1.	Best all-round student Class Prize.	K. G. Joshi.
2.	Phatak's Prize in Agriculture	A. B. S. Verma.

3.	Kalidas Chaudhari Medal for Practical Agriculture.	A. B. S. Verma.

2nd year.

1.	Coronation Commemoration Prize, best all-round student.	M. S. Nair.
2.	Special Prize, best all-round.	M. S. Nair.
3.	Class Prize for Agriculture.	M. S. Nair.
4.	Class prize for Mathematics and Survey.	M. S. Nair.
5.	Class prize for Elementary Science.	T. J. John.
6.	Chakradeo Prize, Practical Agriculture.	R. S. Shivalkar.

1st year.

1.	Special Prize, best all-round.	S. Kazim Hussain.
2.	Class Prize, General Agriculture.	D. P. Persai.
3.	Class Prize, Practical Agriculture.	D. P. Persai.
4.	Class Prize, Mathematics and Survey.	A. B. Mitra.

Inter Class Ploughing Competition Medals won by the 2nd year. (1933-34).

Mr. R. S. Shivalkar.
Mr. T. J. John.
Mr. G. L. Chandore.

The College Debating Society.—Under the auspices of the society five extra-ordinary meetings were held. An account of the previous four meetings has already been published.

At the fifth meeting of the Debating Society Dr. N. N. Godbole M.A., B.Sc., Ph.D., of the Hindu University, Benares delivered a lecture on 'The Butter Problem'. The subject was too technical for the junior students but Dr. Godbole made it so easy and interesting that there was dead silence amongst the audience during the course of his lecture.

The Spence Training College Debating Society arranged for a friendly debate with our College during the visits of our teams to Jubbulpore to play the inter—collegiate matches. The subject of the debate was 'The cult of feminism is ruinous to human progress'. Messrs. T. P. S. Choudhari, M. S. Nair and M. D. Anadeo represented our college, Mr. M. S. Nair speaking in favour of the resolution and Messrs. T. P. S. Chaudhari and M. D. Anadeo against. The debate was a very keen one and the motion was finally lost. We offer our hearty thanks to the Principal, staff and students of the Spence Training College for their cordial hospitality.

We offer our hearty thanks to our President Mr. J. C. McDougall M.A., B.Sc, Principal College of Agriculture for his great zeal and interest in the working of the Debating Society.

The College Gymkhana.—The college sports in connection with the social gathering took place on the morning of the 4th December. All items were well contested and the competitors showed great keenness.

Our thanks are due to Mrs. McDougall who awarded a championship cup for the best tennis player of our college. This was won by Mr. Deoskar this year. Our thanks are due also to Mr. K. P. Shrivastava for the Champion's Cup he has awarded to the best all round sportsman of our college. This was won by Md. Isaque.

The list of prize winners is given below:—

Items of competition.	*1st Prize.*	*2nd Prize.*
100—Yards dash	Md. Ishaque	P. M. Shrivastava
High jump	K. G. Joshi	Y. K. Dabadhkar
Putting the shot	Md. Ishaque	K. N. Dilraj
Long jump	Md. Ishaque	P. M. Shrivastava
220 yards	R. L. Gupta	Md. Ishaque
Sack race	R. C. Belsaray	
Hurdles	R. L. Gupta	Y. K. Dabadhkar
Three legged race	Md. Ishaque	
Mile race	M. M. Khire	R. G. Belsaray
440 yards	R. L. Gupta	N. N. Dilraj
Relay race	1st year Md. Ishaque	...
Tug-of-war	1st year Wahab Khan	...
Volley ball	1st year P. M. Shrivastava	

Tennis Championship cup	... ...	M. K. Devaskar
Tennis Singles Runner up	... ...	R. L. Gupta
Tennis Double Championship	... ...	K. R. P. Nair H. Das
Ping Pong Championship	... ...	V. G. Vaidya
Chess Championship	... ...	P. N. Soman
Recitation Competition.	T. G. Deshpande	P. R. Roday.
All-round Sports Championship Cup.	...	Md. Ishaque

Tennis Club.—The annual gathering of the College Tennis Club was held on the 11th January 1935. The function began at 4 P. M. with a group photo and the party then moved on to the tennis courts where a small at-home was arranged. The function was a success. Many guests were present among whom Mr. and Mrs. McDougall were the prominent. We congratulate Mrs. McDougall for her splendid game of tennis. The management take this opportunity to thank all the members of the club for the keenness they evinced during the session.

Examination Results 1934-35

B. Ag. EXAMINATION, NAGPUR UNIVERSITY.

1st. Class.

V. G. Vaidya*
K. G. Joshi
A. B. S. Verma

2nd. Class.

Bishwanath Sahu
Damodar Patanaik
K. R. Chande
K. S. S. Chowhan
M. M. Khirey
N. N. Bhide
P. M. Ganorkar
S. Bhandari
T. P. S. Chawdhari
V. D. Taparia

3rd. Class.

H. R. Shrivastava
P. Misra
R. A. Haqqani
S. N. Walkade
S. K. Bhisey
Byomkeshranjan Dutt
Y. K. Dabhadkar

Pass.

G. W. Pitale
N. W. Tilloo
P. N. Soman
V. S. Hingankar
G. K. Deshkar
R. N. Kher

Compartmental.

B. S. Venugopal Rao
Haribansa Misra
H. A. Kaiyumi

* Awarded the Chakradeo Memorial Medal and the Sir Arthur Blenner Hasset Memorial Medal.

INTERMEDIATE EXAMINATION NAGPUR UNIVERSITY.

1st. Class.

S. S. Kufalikar*

2nd. Class.

A. B. Mittra
B. V. Bhatt
D. P. Persai
J. L. Sen
K. R. P. Nair
K. U. Tathode
M. K. Deoskar
Mohd. Luqman
N. V. Bapat
V. N. Andhare
W. S. Dehadrai

Pass.

Gajraj Singh
M. S. Kashyapa
Mohd. Nasruddin
V. T. Tanksale
W. R. Deshpande

Compartmental.

P. Harinkhere
R. D. Joshi
S. P. Pimplikar
T. M. Koyal.

* Awarded the "Sir Arthur Blennerhassett Memorial Medal"

THIRD YEAR PROMOTION EXAMINATION.

N. V. Bapat
R. L. Gupta
B. L. Udhalikar
D. R. Soman
D. P. Sharma
D. Chandrayya
G. L. Candore
Lal Harnarain Singh
M. D. Anadeo
R. S. Shivalkar
M. S. Nair
U. G. Deshpande
T. J. John
W. R. Deshpande

FIRST YEAR PROMOTION EXAMINATION.

B. L. Chaudhari
E. N. Dilraj
G. R. Yadav
H. Das
T. T. Saoji
Mohammed Ishaque
M. A. Kolkhede
T. G. Deshpande
R. P. Tiwari
P. L. Shrivastava
D. L. Dixit
D. D. Deshmukh
G. P. Deshpande
G. V. Gondhalekar
G. V. Dhoke
G. R. Shombhekar
M. V. Khankhoje
V. D. Deshpande
P. R. Roday
W. B. Date
P. V. Bapat
R. K. Wadaskar
K. Subbarao
G. D. Dalal
R. C. Belsaray
Asgar Ali Raja
A. R. Kamkolkar
Mohammed Ibrahim
P. M. Shrivastava
G. V. Deodhar
M. K. Reddy
M. D. Shoaib
L. B. Dube
T. N. Supe
M. S. Kiledar
G. S. Tegore
B. H. Tembhre
M. Kesava Das
Y. R. Saoji

Departmental News.

Leave on average pay on Medical Board certificate for two months is granted to Mr. Laxmi Narayan Dubey, Extra Assistant Director of Agriculture, Chindwara in extension of the leave granted to him.

* * * *

On expiry of the leave granted to him Mr. Laxmi Narayan Dubey is reposted as Extra Assistant Director, Chhindwara.

On relief by Mr. L. N. Dubey, Mr. G. V. Bapat, officiating Extra Assistant Director, Chhindwara, reverts to his substantive post in the Subordinate Agricultural Service.

* * * *

On termination of the temporary appointment as Marketing Officer, Mr. J. S. Gurjar is reappointed as officiating Extra Assistant Director with effect from the 1st May 1935 and is posted to Akola.

On relief by Mr. Gurjar Mr. N. S. Gangakhedkar, officiating Extra Assistant Director, Akola, is posted to Drug in the same capacity.

* * * *

On return from the leave granted to him Mr. G. D. Metha, Extra Assistant Director assumed charge of the temporary post of Assistant Marketing Officer in connection with the scheme for the improvement of marketing in India, with effect from the forenoon of the 11th February 1935.

The unexpired portion of his leave i. e. 9 days is hereby cancelled.

* * * *

Mr. N. R. Pande, Agricultural Assistant, Amraoti is transferred and posted to Dharni to work during the absence of Mr. P. B. Dixit, Agricultural Assistant, Dharni, on leave or until further orders.

On relief by Mr. Pande, leave on average pay for one month and 15 days is granted to Mr. P. B. Dixit, Agricultural Assistant, Dharni with effect from the 1st May 1935, or any subsequent date on which he is relieved of his duties by Mr. Pande.

* * * *

Mr. N. G. Shirpurkar, Agricultural Assistant, attached to the Seed and Demonstration Farm, Buldana is transferred and posted to Khamgaon to work during the absence of A. H. Barde, Agricultural Assistant, Khamgaon on leave or until further orders.

On relief by Mr. Shirpurkar, leave on average pay for one and half months is granted to Mr. A. H. Barde, Agricultural Assistant, Khamgaon with effect from the 1st May 1935 or any subsequent date on which he is relieved of his duties.

Leave on average pay for six weeks is granted to Mr. S. R. Ambikar, Agricultural Assistant on grounds of ill health with effect from the 16th April 1935.

* * * *

Mr. B. P. Rawat, temporary Agricultural Assistant Janefal is transferred and posted to Balapur to work in that Tahsil till the end of May 1935.

On relief by Mr. Rawat, leave on average pay for 2 months is granted to Mr. G. V. Bakre, Agricultural Assistant, Balapur with effect from the 8th May 1935.

Mr. M. N. Golwalkar, Agricultural Assistant, Akola will relieve Mr. B. P. Rawat on the 31st May 1935 and remain in charge of the work both in the Akola and Balapur Taluqs during the absence of Mr. Bakre on leave or until further orders.

* * * *

Leave on average pay for three months is granted to Mr. J. V. Takle, Extra Assistant Director of Agriculture, in charge Animal Husbandry Section, Nagpur with effect from the 9th May 1935.

* * * *

Leave on average pay for one month is granted to Mr. S. R. Ambikar Agricultural Assistant, Amraoti in extension of the leave already granted to him under this office order No. 1404, dated the 16th April 1935.

* * * *

Mr. L. B. Deshpande, temporary Agricultural Assistant Chikhli is transferred and posted to Malkapur to work during the absence of Mr. A. S. Bakre, Agricultural Assistant, Malkapur on or until further orders.

On relief by Mr. Deshpande, Mr. A. S. Bakre, Agricultural Assistant, Malkapur is granted leave on average pay for two months with effect from the 1st June 1935.

Calender of Operations

FLOWERS

By R. N. Sinha.

May.—The cold weather annuals will have finished by now. Their seeds should be gathered and cleaned and dried and preserved in air-tight bottles or tins with labels for next year's use. Seeds like Aster, Pink,

Phlox, sweet-peas, Petunias, Candytuft, Nasturtium, Cornflower, Alyssum; Antirrhinum, Larkspur, Clarkia etc. do not deteriorate for two or three years.

When the seeds have been collected, the plants should be pulled out as soon as possible, and the beds dug out to a depth of about 2 feet, and the excavated soil left exposed to sun and air for about 2 or 3 weeks.

Afterwards well rotted cattle-dung manure in the proportion of two of soil and one of manure may be well mixed with the soil and returned to the pits. Horse dung, night-soil or town sweepings can also be added with advantage, of course in a well decayed form.

Potting soil for general use may be prepared in the following form and kept ready for use during the rains.

2 Parts soil; silt preferable.

1 Part cattle dung.

1 Part leaf mould.

1/4 Part sand in absence of silt.

1/8 Part charcoal dust.

Seed beds should be prepared and kept ready for sowing early in June. These beds should be about $4\frac{1}{2}$ feet in width and 9" higher than the ground level. The length may be according to requirements. A mixture of cattle dung and leaf mould manure in the proportion of half and half would make a suitable composition for seed beds. A layer of this about $1\frac{1}{2}$" in thickness would be enough over the seeds beds. Manures like horse-dung and Poudrette should be avoided for seed beds as far as possible. It would be worth while soaking the seed beds 10 or 12 days before the actual date of sowing the seeds.

The following seeds may be ordered for the rainy season.

1. Zinnia.
2. Balsam.
3. Cosmos.
4. Sunflower Big.
5. Sunflower small.
6. Celosia.
7. Gomphrena.
8. Melampodium.
9. Torenia
10. Hollyhock.
11. Marigold.
12. Cacalia.
13. Gillardia.
14. Calandula.
15. Datura.
16. Amaranthus.
17. Cleome (spider flower.)

Where hedges or borders are to be planted, a trench 1½ feet deep and 1½ feet broad may be dug and the soil exposed to the sun. If manure is available easily, it may be added in the proportion of 3 to 1. aud the trench filled in and kept ready for sowing the seeds or inserting cutting of hedges and borders.

The following varieties are suitable for hedges and borders:—

Hedges.	*Borders.*
1. Haematoxylon.	1. Eupatorium.
2. Ingadulcis.	2. Pedilanthus.
3. Dodonia.	3. Pedilanthus variegata.
4. Duranta.	4. Justicia.
	5. Althernanthera.

Surface drains should be cleaned and new ones dug, wherever necessary. Drainage is one of the important factor in plant life.

Caladium and Hamanthus bulbs should be removed from storage and made to sprout by about the middle of this month. Dhalia tubers should be potted in leaf mould for sprouting. Caladium and Hemanthus bulbs can be potted independently after separating the bulbs, the size of the pot depending upon the size of the bulbs. Put a little fine sand round about the bulbs while potting. Charcoal dust will be valuable in caladium soil for obtaining good colours.

June.—The seeds obtained in the last month for the rainy saason may be sown in two lots, first lot on or about the 6th and the second lot a week later. The seedlings will be fit for transplanting in about 2 to 3 weeks time.

Dahlia bulbs will be fit enough for separating by the 1st week. These may be potted 6" and 8" pots, and lateron in 15" pots

Roses will have to be pruned and manured by about the 3rd week. Pruning need not be heavy in this season.

It is advisable to prune the ornamental and flowering shrubs also by the end of this month in order to keep them in shape and control, and to encourage their free flowering tendency.

This is the best time for sowing seeds or for planting cuttings of hedges and borders.

Cannas may be transplanted in this month. Violets and Geraniums in pots may be removed to some shady open verandah in order to protect them from the rains or other-wise they would be spoiled.

The rooted cuttings of Eduard Rose may be potted in pots or planted in beds for budding in the next cold season.

July.—Any operations which could not be finished in the last month may be carried out in this month with safety.

This would be the proper time for repotting pot plants.

Croton cuttings may be planted in a mixture, of coarse sand and leaf mould manure. In this month Dahlias will be getting ready for putting in big pots.

Hanging baskets may be renewed. Rockeries also should be renewed or new ones planted. Whenever possible, the flower beds planted in the last month should be hoed or their soil loosened by a *khurpee.*

For obtaining good results, remove the first flowers of zinnias, which are generally single ones. Remove the side shoots of balsams, as flowers produced on the stem are always double, full, and more showy.

VEGETABLES

May.—In order to have an early crop, the following vegetables may be sown by the 2nd or 3rd week of this month.

Maize
Snake gourd
Bottle gourd
Pumpkin
Vegetable marrow (*Dilpasand*).
Spange gourds (*Turai*).
Ladies fingers (*Bhendi*).
Cluster beans (*Gowar Palli*).
Cucumber
Tomato (*Occlimatized*).
Brinjals
Chillies

Artichoke tubers preserved in the ground may be given regular irrigation any time from the 2nd week of this month in order to help germination, so that plants may be ready by the 3rd week of June for transplanting.

June.—2nd sowing of the vegetables suggested in the previous month may be done in the 2nd or 3rd week of this month in order to have a regular and continuous supply. In addition to the above the following vegetable seeds may be sown at any time in this month.

Gooseberry (*tipari*).
Country beans (*sem*).
Asparagus beans (*cholai*).
Goa beans (*chaudhari*).
Velvet beans (*kach-kuri*).
Sword beans (*tamtama*).
Double beans
Rosella (*lal ambari*).
Ashy gourd (*bhura kumhra*).
Arum (*ghunya*).

Artichoke, chillies, brinjal and tomato seedlings would be ready for transplanting. Maize sown in the last month may be earthed up.

July.—Any vegetables, those suggested in the previous months, could be sown in this month.

Special attention will have to be paid to the weeding and drainage of the standing crop.

Cucumbers beans snake gourds etc would require supports for climbing. For cucumbers and beans branches of trees would be quite enough but for snake gourds *mandua* or *machan* will have to be provided.

Acclimatized lettuce seeds may be sown in this month.